A TREATISE

ON THE

STRUCTURE,

FUNCTIONS AND DISEASES

OF THE

HUMAN SYMPATHETIC NERVE.

ILLUSTRATED WITH PLATES.

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TRANSLATED FROM THE LATIN, WITH NOTES,

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TO

WILLIAM E. HORNER, M. D.

PROFESSOR OF ANATOMY IN THE UNIVERSITY OF PENNSYLVANIA,
MEMBER OF THE AMERICAN PHILOSOPHICAL
SOCIETY, ETC. ETC.

Whose elevated principles and private virtues have attached him to all that participate in his acquaintance,

AND

Whose devoted and most successful cultivation of Anatomy and Pathology, as well as other departments of Medical Science, have reflected the highest honour upon the Institution to which he belongs,

THESE PAGES ARE

MOST RESPECTFULLY INSCRIBED BY

THE TRANSLATOR.

AMICIS CONJUNCTISSIMIS

RENATO CAILLIOT

FACULT. MEDIC. ARGENT. PROFESSORI ATQUE DECANO

FRANCISCO DANIELI REISSEISSEN

ORPHANOTROPHII ARGENTORATENSIS MEDICO PRIMARIO

HASCE PAGELLAS

GRATA MENTE OFFERT

AUCTOR.

AUTHOR'S PREFACE.

THE subject of which I have undertaken to treat, is in the universal opinion of physiologists one of the most difficult kind, in consequence of the amplitude of the field it embraces, and the arduous investigation, which it necessarily involves. Its due consideration not only requires anatomical research, but also well directed physiological experiments, and correct pathological observations. As respects the former, I am convinced, that a general anatomical description or disquisition in relation to the nervous filaments of the organs, would not suffice; but that the investigation should be so extended as to embrace those constituting the internal structure of the nerves, and especially of the *ganglia*.

The *nerve* denominated *Great Sympathetic* is composed agreeably to the opinion of the most recent physiologists, of a nervous system or apparatus, belonging principally to the abdominal viscera, and interrupted by tubercles or nodes, which bear the name of *ganglia*. From this arrangement the apparatus, has been long known under the name of *ganglionic system*, which is wholly different in its uses and functions, from the system of cerebral and spinal nerves.

They however, commit the grossest error who refer all the ganglia to the sympathetic nerve, and deny their

existence in the other nervous system. For it is demonstrated by anatomical investigation, that at least thirty-six pair of ganglia, appertain to the cerebral and spinal nerves; that is, those under the subjection of the will and entirely foreign to the function of digestion and chylification. It will therefore be right to leave unnoticed the ganglia of the pneumogastric and spinal nerves; as well as the cerebral tubers, &c., which have very recently been denominated ganglia, and to circumscribe this treatise within such limits, that it may embrace only the "*Structure, function and diseases of the Sympathetic Nerve.*" The order of the subject before us, is apparent from the title which I have prefixed to this commentary.

I have therefore in the *first and anatomical section*, treated of the situation, course, branches and anastomosis of the sympathetic nerve. Afterwards, I have undertaken to investigate the arrangement of the plexuses, and the structure of the ganglia, having first premised some observations, in respect to the evolution of this system in the embryo and fœtus.

But in describing the situation and course of the sympathetic nerve, I concluded the right mode to pursue, would be to consider it as a single nervous funicle, extended between the head and the pelvis, inflated indeed into many ganglia, but never or at least very rarely divided and completely interrupted in its course.

All anatomists, the celebrated BICHAT excepted, have taken a similar view of this nerve, and such it appears at first sight, to the least skilful inquirer, and to the

utterly unpractised eye. The other method of description introduced by BICHAT, could only be admitted in case the ganglia were irregularly placed, and here and there scattered in disorder; if the plexuses which are situated separately, were not connected together or with any central trunk; if, in fine, this nerve did not exhibit innumerable varieties in its seat, course, and ramifications.

I have, therefore, under the name of *intercostal*, *sympathetic*, *great sympathetic*, and *trisplanchnic* (Chaussier,) considered and described the nervous cord, as being extended in the length and axis of the body, and possessing two extremities, the cephalic and pelvic. In this way the idle question in respect to the origin or termination of the nerve is avoided.

As to the distribution of the intercostal nerve, I have referred the question, involving the reception and emission of its branches, to another head; and in order to avoid all subtle and merely theoretical controversy, I have in the anatomical section of this work, distinguished the branches of the sympathetic nerve into external and internal. The former consist of those, which situated more remotely from the axis of the body, constitute a connection between this nerve and the spinal nerves; the latter, of those which are distributed to the organs, and always accompany the vessels.

Though I had previously dissected many bodies for the sympathetic nerve, in which I always observed some variation in the origin and distribution of its branches, yet I considered myself bound, in order to furnish a more perfect production, to make use of the

body of a young man, twenty-four years of age, who had been affected with congenital imbecility of mind, and in whom the sympathetic nerve was so perfect and well expressed, as to surpass any I have ever seen in fitness for dissection. From this subject my description is principally derived. I have likewise adduced the observations made either by other anatomists, or myself, which manifest less usual phenomena; but have referred them to the second chapter of the first section, so as to avoid interruption in the order of this treatise.

In the *second and physiological section*, I have endeavoured to display the use of the intercostal nerve in the animal economy, and its probable functions in a healthy condition.

Lastly, in the *third and pathological section*, I have indicated the abnormal actions or diseases of this nerve, in which it appears to be affected in a *dynamic* manner only: And I have then treated of the *organic changes*, which have been detected by anatomical research in the structure of the nerve itself.

ON THE

STRUCTURE, FUNCTION,

AND

DISEASES

OF THE

HUMAN SYMPATHETIC NERVE.

SECTION FIRST. ANATOMICAL.

CHAPTER FIRST.

General description of the Sympathetic Nerve.

§ 1. Concealed in the carotid canal, upon and in company with the carotid artery, and in junction with the cerebral nerves, are found a few delicate filaments, which are considered the beginning or origin of the Sympathetic Nerve.

Before MECKEL traced out the Vidian nerve and disclosed a small branch running deeply in the carotid canal, anatomists had deduced the Sympathetic nerve of man, from the sixth cerebral pair only. Since then, authors have understood correctly, its double origin, or two roots; namely, from the fifth and sixth cerebral nerves.

This mode of description stood its ground in the schools, until within a recent period, when this portion of the Sympathetic nerve ceased to be considered as its origin and source, but only as a mode in which branches proceeding from the uppermost cervical ganglion ascended towards the head.

Acceding to this opinion, I shall describe what I have myself observed at the cervical extremity of this nerve, and in the second chapter pursue its historical details.

§ 2. I have seen three small branches running backward from

the sixth pair of nerves, or forming an obtuse angle with it, placed upon the carotid artery near its third flexure, and forming a reddish gangliform plexus, which was increased by a filament from the Vidian nerve.*

From this ganglion, beside two fasciculi of soft filaments, two especial branches pass out, upon the coats of the artery, one behind the carotid, the other upon its upper surface, which when they reach the lowest portion of the carotid canal, coalesce into one slender cord, to which the name of Sympathetic nerve is given. I have had an accurate representation made of this portion of the Sympathetic nerve, with the branches drawn out a little from the artery, in order to render their course more conspicuous. See plate 6th, fig. 1st of this work.

In another subject the following was the relation of the small nerves running in the carotid canal.

An *olive shaped ganglion*, three lines in length, and one line thick, was placed in the middle of the carotid canal, eight lines distant from the first cervical ganglion, with which it was connected by a slender cord. Five small branches were given off by this cavernous or carotid ganglion, three of which formed a network round the carotid artery, whilst the two remaining formed an anastomosis, between the sixth nerve and the Vidian. A branch to the first nerve was divided into two filaments, which were reunited directly with the nervous trunk.

From an attentive examination of the subject, I have been convinced that the sixth pair of nerves may be separated into two principal branches, superior, and inferior; the first of which forms an anastomosis with the Sympathetic nerve.

Formerly it was disputed whether this branch from the sixth nerve of the cerebrum, should be considered as received or emitted. In favour of the former opinion there is, 1st, the obtuse angle, which this branch forms with the trunk of the sixth

* In a coloured plate of the Sympathetic nerve, with marginal descriptions, lately issued under my inspection, from one by M. Manec, by Mr. P. Ancora, a distinguished artist of this city, this arrangement may also be distinctly seen. The Vidian nerve, as there designated, No. 11, occasionally sends two branches into the carotid plexus.—*Translator.*

pair which leads to the orbit. 2d, Its division near its anastomosis, which furnishes additional proof that it proceeds towards the ganglion. 3d, Lastly, the union of this same branch in a common fasciculus with the sixth pair of nerves, (motor externus.)

But the whole of this question is vain and idle at the present time, when that portion of the Sympathetic nerve, concealed in the carotid canal (as the expression runs) is no longer considered its origin.

§ 3. The Sympathetic nerve having passed out of the carotid canal, appears at first as a soft, red funicle. Afterwards it enlarges into the *superior cervical ganglion*, denominated from its figure, *olivary*.

I have seen this ganglion twenty lines in length, and three in diameter: in another subject, and upon both sides it was thirty-four.

It is situated upon the superior part, and towards the external margin of the rectus capitis major muscle, covered at first above by the internal carotid artery, in front of which, however, it quickly appears. Anterior to it descends the Glossopharyngeal nerve; and exterior, and a little posterior to it, lies the internal jugular vein, the par Vagum, and last of all the Hypoglossal nerve.

I have found the upper cervical ganglion double. The trunk of the Sympathetic nerve in this case immediately after having left the carotid canal, separated into two parts, one internal, and the other external, which communicated together by branches of considerable size.

That which may be called the interior ganglion, was fifteen lines long and three in diameter. The exterior ganglion was an inch long and three lines thick, and was joined with the Hypoglossal nerve, by two anastomosing branches. The branches which were sent downwards by this double ganglion, united into a single cord, about the middle of the neck, and constituted the trunk of the Sympathetic nerve.

Of the internal composition of the ganglia, I shall treat farther on; when, too, I will more carefully investigate the condition,

size, and structure of the olivary ganglion. It suffices now, in a general way, to have indicated its position.

§ 4. This ganglion having been formed, the trunk of the Sympathetic nerve, is compressed in size, and descends as a small cord, half a line in thickness, perpendicularly behind the carotid, until it touches the inferior thyroid artery, when it is enlarged to form the second ganglion, called the *middle cervical*, or *thyroid ganglion*. This ganglion is frequently deficient; I have on the contrary, however, many times found it large and of a remarkable triangular form: it is of a red colour, like all ganglia, but less juicy, and a little harder than the upper cervical ganglion.

§ 5. The middle cervical ganglion being formed, the trunk of the Sympathetic nerve (intercostal) is again compressed for a short distance, the space of an inch, when it is enlarged a third time, and produces the last or *inferior cervical ganglion*, which is situated near the internal margin of the vertebral artery, and nine lines distant from the subclavian.

The ganglia of the two sides do not always resemble each other: neither do they perfectly correspond in regard to figure, situation, and disposition.

For example; the middle cervical ganglion may be deficient on one side, and present on the other.

The upper cervical ganglion is sometimes found short upon one side, and long on the other: and sometimes double upon one, and single on the other, (as I found it in the case cited above.) It appears to me that the first cervical ganglion, when of a greater size than usual, assumes the functions of the deficient middle ganglion.

§ 6. The Sympathetic nerve, after having formed the last cervical ganglion at the margin of the thorax, passes, after a course of two lines, the head of the first rib, where a large ganglion is formed, which is covered by the vertebral artery, and called from its situation, *first thoracic*, or *great thoracic*.

It will be proper to pause here for a time, that we may more carefully consider what we have said above in a summary way,

and investigate the branches sent off in the neck from the Intercostal nerve.

§ 7. In returning therefore to the first cervical ganglion, it is well to recall to mind, that that body of close cellular network, is adherent to the par vagum, and hypoglossal nerves, but without any intermixture of the nervous pulp. Two white and consistent branches are seen to proceed from it, transversely, and which are enlarged by a nervous connection from the first and second cervical nerves. A third, but longer and more slender branch, is sent obliquely downwards, and connects this ganglion with the anterior descending branch of the second pair of cervical nerves. A fourth, yet smaller and longer than the last, having given off some fine filaments to the rectus capitis major anticus muscle, is united to the third cervical nerve.

There is a connection, therefore, between the first cervical ganglion, and the three superior cervical nerves, by the means of four intermediate anastomosing branches.

§ 8. From the same ganglion, beside the filament to the tympanum, which is more fully described in the second chapter, the following branches emerge.

The first one we discover is red and firm; it passes upwards, and is distributed to the belly of the rectus capitis major anticus muscle, the inferior part of which it perforates.

The second branch is likewise red, and extends to the pharynx. It is divided into three fine filaments, which are spent upon the salpingo-pharyngeus muscle,* but first connected by anastomosis, with the glosso-pharyngeal nerve, and the pharyngeal branches of the eighth pair. Thus a plexus is formed, from which some twigs are sent to the trunk of the external carotid.

The third branch, which was formerly considered double or triple, is pulpy, red, thick, and almost pellucid, and called from this circumstance, *mollis:* having connected itself with the laryngeal branch of the eighth pair, it is subdivided into five branches, that proceed forward to the superior thyroid, laryn-

* Salpingo-pharyngeus, is a name given to a few fibres of the Palato-pharyngeus muscle, which assist in dilating the mouth of the Eustachian tube. *Translator.*

geal, lingual, and external maxillary arteries, in company with which their ramifications run.

§ 9. The laryngeal nerve itself, above cited, a branch of the eighth pair, does not in descending over the upper surface of the superior cervical ganglion, cohere with that body of cellular network, but receives the soft nervous substance from this ganglion, as I have very distinctly seen by the aid of a microscope. The branch of the fifth pair which adheres at the side of the sella turcica to the back part of the ganglion of Gasser, is evidently situated in the same way.

From this we may conclude that the filaments of the laryngeal nerve, in the case described are of a mixed character, partly formed by the par vagum, and partly by the intercostal nerve. This arrangement is particularly important, in regard to that branch of the laryngeal nerve, which is given off near the origin of its own trunk, and received afterwards upon the external carotid artery, in its course to the superior thyroid. This branch, connected evidently with the superior cervical ganglion by a yellow semilucid nervous pulp, which the microscope places beyond all doubt, passes immediately to the basis of the larynx, and is spent upon the crico-thyroid muscle, after having sent forward three twigs to the thyroid gland.

But in some subjects, I have seen this branch of the laryngeal nerve, proceeding from the cervical ganglion to the crico-thyroid muscle and thyroid gland, without any connection with the par vagum.

It should however be observed, that when no intermixture exists at the origin of the nerves from the par vagum and sympathetic, it takes place soon after by the anastomosis of their branches.

§ 10. For whatever may be the origin, number, or diversity, of these nerves, and the inconstancy of their natural division into branches, this may be admitted as invariably true, that the superior cervical ganglion sends off some soft branches, and others of greater consistence, from its anterior face, which always proceed partly to the internal, but principally to the exter-

nal carotid artery, which they invest in various ways, attend in every direction, and are finally spent in filaments to their tunics. Moreover all these ramifications, the course and complexity of which are diversified with accessory filaments from the glosso-pharyngeal nerve, and the pharyngeal and laryngeal branches of the eighth pair, likewise form a long plexus, which has been divided by Haller into pharyngeal and laryngeal, of which sometimes one and sometimes the other is more strongly developed.

§ 11. The fourth and last branch from the superior cervical ganglion, which is long and slender, descends along the carotid artery, to the aorta. It is known by the name of the superficial cardiac nerve, and is usually formed in part by the par vagum, or in other words is formed by a root from each. In a case which I examined with close attention to this subject, it was formed (on the right side) by a delicate branch from the par vagum near the laryngeal nerve, which was quickly strengthened by nervous substance coming off under the form of a diaphanous filament from the ganglion. The superficial cardiac nerve thus formed, was connected with the par vagum, upon a level with the fourth cervical vertebra by a transverse filament. It then plunged into the middle cervical ganglion, and being again increased in size, advanced at once to the arteria innominata, and having supplied some filaments to that artery, anastomosed with a branch from the par vagum, and formed a plexus which was connected to the great cardiac plexus, as will be explained below.

§ 12. The second ganglion of the intercostal nerve, called as I have said, thyroid or middle cervical, is six lines long and four broad, and situated two lines above the inferior thyroid artery. It has a long and very delicate communicating branch with the fourth cervical nerve, and another larger one with the fifth. These branches are the most superficial. Two other branches also exist, which pass out deeply from the same ganglion. The former of these is soft and succulent, very conspicuous, and perforates the muscular space between the transverse apophyses, of the fourth and fifth cervical vertebræ, and then

divides into two diverging branches; the exterior one is joined to the fifth pair of cervical nerves, opposite to that point which supplies the posterior branch. The interior branch ascends in the canal, formed in the transverse apophyses for the vertebral artery, upon the tunics of which it is spent.

The other evidently pursues the same course as the preceding branch, namely, perforates the interval filled up by the inter-transverse muscles; then is divided into two branches, the exterior of which communicates with the sixth pair of cervical nerves: the other, internal, attends the ascending vertebral artery.

Hence it follows, that the middle cervical ganglion communi cates with the fourth, fifth and sixth cervical nerves, and with the fifth likewise by two branches one of which, is superficial and the other deep seated. The deep seated communicating branches were seen and described by the illustrious Sabatier* in his treatise of Anatomy.

§. 13. One of the branches which pass anteriorly from the middle cervical ganglion, extends to the tunics of the primitive carotid artery: another in following the course of the inferior thyroid artery sends some filaments to the thyroid gland, and others to the subjacent œsophagus; whilst the rest which are inferior, seem agglutinated to the surface of the trachea, and are spent in the vasculo-cellular network, which occupies the seat of the thymus gland in the adult.

§ 14. The third cervical ganglion is only two lines distant from the first thoracic, with which it is connected in three different ways.

Firstly, by the continuation of its trunk—Secondly, by two very small branches forming a kind of loop round the vertebral artery—Thirdly, by a larger branch sometimes double, which has been long known under the name of *Ansa Vieussenii*, and passes round the subclavian artery.

This ganglion (the third cervical) had no connection with the

* Traite d'anatomie (Nevrologie) tom. IV. p. 308. Edit. 1792.

cervical nerves in most of the subjects that I have dissected; therefore the large ganglion which follows next, is called *great* or *first thoracic*, the seat of which I have pointed out above.

§. 15. This ganglion, situated near the last cervical, and very frequently continuous with the second thoracic, forms a large elongated node, shaped like the letter S turned horizontal, from which many branches internal and external pass out.

The internal, about five in number, form an anastomosis with the seventh and eighth* cervical, and first dorsal nerves; the first of these nerves indeed receives only one branch from the ganglion; The two remaining on the contrary, receive five branches which are short, round and succulent.

The external, seven in number follow the subclavian (right) though there are other filaments inosculated with branches from the par vagum and the recurrent nerve, which descend around this vessel towards the arteria innominata, and increase the number to about thirteen.

The internal, collected at first into a broad fasciculus through the intervention of loose cellular tissue, soon separate as they advance, are spread upon the arteria innominata, and receive the external branch of the superficial cardiac nerve near the origin of the primitive carotid: After which a large plexiform loop is formed round the subclavian, innominata and primitive carotid arteries, and the trachea, proceeding from within as it were towards the surface, to which the name of *cardiac plexus* is given.

In order to furnish a complete history of the cardiac plexus, it will be necessary now to repeat the description of the superficial cardiac nerve given above (§. 11.) For repetitions are by no means objectionable when they diminish the obscurity of a subject.

§. 16. The superficial cardiac nerve, arises either separately from the intercostal or pneumogastric nerve or from both together, and descends upon the carotid under the form of a white consistent filament, which appears somewhat increased in size after its conjunction with the middle cervical ganglion.

* Here the suboccipital is counted as the first cervical, making eight nerves to the neck.—*Translator.*

In whatever manner the Superficial cardiac nerve is formed, as it passes to the arteria innominata it is divided into five branches, three of which proceed to the arteria innominata and aorta, and form a simple plexus, called the *superficial cardiac*, whilst the two remaining external branches anastomose with a branch from the par vagum, and with another from the first thoracic ganglion descending under the subclavian artery.

The plexiform nervous loop is strengthened by this double anastomosis, and is now denominated the *cardiac plexus*, from the convexity of which many branches descend to the base of the heart.

Although the great cardiac, or deep seated plexus, is of very intricate construction on account of the anastomosis and division of its nerves, yet we know from analytic investigation that all its branches have a triple origin, and that they pass to the heart.

§. 17. From what has been said above it may be collected that the cardiac plexus has a triple origin.

1st. At its interior part near the carotid and innominata, from the superficial cardiac nerve, and by some accessory filaments from the par vagum.

2d. At its middle part, from nerves proceeding from the inferior cervical ganglion and first thoracic, after they have formed an anastomosis with the recurrent and with the superficial cardiac nerve.

3d. At its exterior part, from branches sent off from the trunk of the par vagum itself.

Hence it follows that the interior and anterior cardiac nerves, proceed chiefly from the superficial cardiac nerve; the middle, principally from the last cervical, and first thoracic ganglion; the exterior and posterior, chiefly from the par vagum, although no branch of the cardiac nerves can be traced simply from the Intercostal free of all connection with the par vagum.

§. 18. Two of the branches of the middle nerves of the cardiac plexus are more conspicuous than the rest, having their chief source from the lowest cervical and first thoracic ganglion though some accessory filaments are also derived from the superficial cardiac

and recurrent nerves. These which it will be proper to name the *deep-seated nerves of the heart*, one of which is the *principal* and the other a *collateral* branch, descend at their upper part between the trachea and aorta; they pass immediately to the heart, and are received between the aorta, and the right branch of the pulmonary artery, where they are interlaced with branches from the par vagum, and the principal cardiac nerve of the left side.

The anatomical history of the *cardiac nerves near the heart* next claims our attention, and which I will dwell somewhat upon as it now excites the attention of many distinguished men.

We will commence with a description of each branch, and afterwards treat of them in general.

§. 19. The *principal cardiac nerve* which WRISBERG* calls *maximus* or *novus*, as it arrives at the origin of the arteria innominata, swells into a *ganglion*, that may be called the *cardiac*, from which three branches emerge in different directions, viz. *anterior*, *posterior* and *middle*: This last from its thickness and direction is considered the continuation of the trunk.

The first of these branches, the *anterior* and right, is of considerable size; is reflected round the aorta to the posterior surface of which it seems at first agglutinated, passes into a sulcus between the base of the right ventricle and right auricle, and forms an anastomosis with the right branch of the left cardiac nerve, by which a kind of coronet is formed around the base of the aorta. Then after having received the filaments from the left cardiac nerve, it gives off two ascending branches to the auricular appendix of the right sinus, which evidently go to the muscular fibres. It afterwards attends the right coronary artery in its course, divided into two branches, which are placed between the trunks of the artery. All the ramifications which proceed from these branches, form a lesser plexus which may be properly denominated the *right coronary*.

§. 20. The *middle branch* of the *cardiac ganglion* or the

* De Nervis, arterias venasque comitantibus Comment. §. 25; Sylloge comment. anat. Gœtting, 1786, in 4to. p. 59.

continuation of the trunk, descends to the lowest part, between the aorta and pulmonary artery, and there with an adjuvant branch from the left principal cardiac, constitutes a considerable plexus, consisting generally of eight small branches: The *external* of which, appertain to the base of the aorta; the *middle* to the origin of the pulmonary artery, whilst the *posterior* and more important branches, descend behind the pulmonary artery, and being finally subdivided into six filaments form a sort of secondary plexus, which may be denominated, the *left coronary*.

The following branches from this plexus particularly deserve attention; 1st. One posterior to the rest, ascending over the origin of the left coronary artery, and passing to the auricular appendix of the left sinus of the heart, in the substance of which it is spent unaccompanied by any vascular branches. 2d. A branch of considerable size descending over the base of the left ventricle, which penetrating within is terminated in the papillary muscle of the heart, also without any accompanying artery. 3d. Two principal branches passing down with the left coronary artery. One of the filaments of these branches, leaving the artery, proceeds very evidently into the muscular structure of the left ventricle.

§. 21. The *posterior branch* of the cardiac ganglion, appertains chiefly to the pulmonary artery; the right division of which consists of four or five filaments joined together by nervous loops; the left, but of two or three, as an anastomosis is formed with the branches of the left cardiac.

§. 22. The *collateral branch* of the principal cardiac nerve, (§. 18.) proceeds from the deep-seated cardiac plexus; it runs an equal distance with the preceding nerve, and is connected with it behind the arteria innominata, by a transverse anastomosing branch. It afterwards attends the left branch of the pulmonary artery, to which it distributes filaments, and having passed behind it, is finally immersed in a plexus situated above the left ventricle.

§. 23. The description of the cardiac nerves of the *right side* being completed, the entire history of the nerves of the heart

would yet be defective, were we to leave unnoticed the nerves which proceed from the left side of the body. It is likewise the more necessary to indicate them, as the nerves of both sides most frequently run together upon the base of the heart, and have a close connection with each other.

In examining accordingly with the greatest care, the subject above described, the origin and course of the nerves belonging to the left side of the heart, appeared as follows.

No superficial cardiac nerve existed, either from the superior cervical ganglion or the eighth pair. But the middle cervical ganglion sent off a very conspicuous strong filament, which descended behind the carotid artery, and having formed an anastomosis with the recurrent nerve of Galen, as the *principal cardiac nerve* advanced immediately to the base of the heart.

On the contrary the first thoracic ganglion, supplied the *superficial cardiac nerve* which descended indeed behind the subclavian, but sent small superficial branches to the carotid artery and aorta.

An inverse relation therefore clearly exists in the origin and disposition of the cardiac nerves of the left and right side.

The principal cardiac nerve in its ulterior distribution descends towards the base of the heart, upon which it is received between the concavity of the aorta and the left branch of the pulmonary artery. An anastomosis is then formed between this cardiac nerve and the collateral cardiac nerve of the right side.

Afterwards it is divided into two principal branches: the first of which, or external, having anastomosed with the posterior branch of the right deep-seated cardiac nerve, gives off three or four small branches to the left pulmonary artery. The second or internal, apparently a continuation of the trunk, situated deeply between the aorta and pulmonary artery, again divides into three branches.

1st. One for the left coronary plexus.

2d. A second for the subjacent trunk of the pulmonary artery.

3d. A third, which in union with the circumflex branch of the right cardiac, surrounds the base of the aorta like a coronet, then

passes to the right ventricle, strengthens the right coronary plexus, and among others sends two branches to a part of the right ventricle near the pulmonary artery, which in company with the arteries evidently proceed to the muscular fibres of the heart.

§. 24. It is necessary now in order to complete the history of the cardiac nerves, to point out the connection of the par vagum with the heart and its great vessels.

There is no branch directly given off from the par vagum to the ventricle of the heart, although the cardiac nerves in the deep-seated cardiac plexus, are mingled with the par vagum as described above. But the branches of the pulmonary artery form an exception, as they receive the filaments which are given off transversely from the par vagum; for one branch only is given off from the par vagum of the right side, previous to the origin of the anterior pulmonary plexus. This branch extends to the right pulmonary artery, leaves with it three or four small ramifications, then descends to the right pulmonary vein upon which it is spent in three filaments, the last of which disappears, as it approximates the right sinus of the heart. Though these branches to the pulmonary veins were not seen by the celebrated SABATIER,* yet I must from autopsic examination admit their existence. It is admitted by the distinguished BEHRENDS.†

§ 25. From the description and course of the cardiac nerves, as above given, this general proposition may be drawn, that the right cardiac nerve alone, chiefly presides over the heart; whilst the left seems accessory only, and to exist for the purpose of sending off some branches, with which those of the right side are strengthened. Another deduction has lately been made by the celebrated *Scarpa*,‡ viz., "that the ramifications from the cardiac nerves of each side, crossing each other evidently at the base of the heart, spread over that organ in such a manner, that every portion of it, anterior and posterior, receives a filament from

* Loc. Cit. p. 218.
† Dissert. inaug. qua demonstr. cor. nervis carere; Mogunt. 1792 p. 10.
‡ De nervis cardiacis, § vii.

the cardiac nerve of each side." But I cannot agree with this illustrious man, when he pronounces the cardiac nerves to be of a very *soft, gelatinous character.** I have indeed found them very small and delicate, but not softer than those derived from other sources. But among the cardiac nerves themselves, there appeared to me some difference in regard to the character of the distributing branches, viz. that the deep seated cardiac nerves, situated between the aorta and pulmonary artery, were less round and cylindrical, and less succulent than the rest, but appeared rather [illegible] flattened down and agglutinated to the parietes of the vessels.

§ 26. The history of the cardiac nerves now being completed, we will return to the trunk of the intercostal nerve, which we relinquished at the first thoracic ganglion.

That ganglion which bears a very large share in the production of the cardiac plexus, emits, beside the cardiac nerves, some slender filaments to the voluntary muscles; viz. to the inferior part of the longus colli muscle.

Another very slender filament appeared to me to proceed to the anterior longitudinal fascia of the vertebral column, and obscured by the ligamentous fibres of the latter to penetrate into the bone itself.

§ 27. The first thoracic ganglion being completed, the intercostal nerve is again compressed in size, and having passed a short distance, swells out again anew into the second ganglion. In some subjects, however, these two ganglia are inflated into one.† The trunk afterwards descends near the vertebral column, passing deeply along the superior part of the dorsal spine, but emerging a little upwards, near the last thoracic vertebra.

In each costal interval, the trunk forms a small ganglion, called from its figure, *hordeiforme;* hence (with the above) twelve ganglia are formed, of which some, like those of the

* Loc. Cit. § xxiv.

† This articulation of the ganglia, also occasionally occurs between the first thoracic, and the inferior cervical, an instance of which is given in the plate to which I alluded, page 10. In that plate also will be found a good delineation of the cardiac nerves of the right side; those of the left side being necessarily concealed by the position of the body.—*Translator.*

neck, are connected with the spinal nerves. For each of the costal spinal nerves emit one, two, or three small branches, which descend obliquely to the adjoining ganglion.

From the first of these hordeiforme or thoracic ganglia, numerous small branches proceed, which by following the intercostal arteries extend to the aorta, upon the cellular coat of which they are evidently spent.

§ 28. But from the sixth thoracic ganglion, to the tenth or eleventh inclusive, three or four branches arise, which, passing forwards and downwards upon the dorsal vertebræ, coalesce into one trunk called *greater splanchnic*, which penetrates into the cavity of the abdomen, through the hiatus between the first and second crura of the diaphragm. WRISBERG* has never found the roots of the splanchnic nerve, less than three, or more than eight in number.

This *splanchnic* nerve is called *greater*, because another nervous cord, smaller in size, proceeds from the ninth and tenth thoracic ganglia, passes into the abdomen through the same hiatus with the greater splanchnic, and immerses itself in the solar plexus, as is yet to be described.

Lastly another branch is constantly found arising from the eleventh and twelfth ganglia, which penetrates into the abdomen through an hiatus of its own in the crura of the diaphragm, and extending to the kidney, is mingled with the renal plexus, and therefore called the *renal* nerve. WRISBERG† first gave this nerve the name of *lesser splanchnic*, which is likewise cited by WALTER, though he did not devise it.

§ 29. In one instance I observed an unusual ganglion, situated upon each side of the dorsal spine, and formed by the greater splanchnic nerve, before it had emerged from the chest. It was two lines in diameter, and in the form of a crescent, from the convexity of which, six or eight delicate filaments emanated; they accompanied the aorta but were all spent in the muscular substance of the crura of the diaphragm.

* Loc. Cit. § 21. † L. C. § 19.

In another instance I found in the body of a male idiot, a supernumerary ganglion, but which differed somewhat from the preceding, as it was placed between the filaments of the splanchnic nerve, from some of which it was formed. The ganglion of the right side, six lines long, and two lines thick, gave off three branches; two of which penetrating into the abdomen, terminated in the semilunar ganglion: the third passed into the superior mesenteric plexus. On the left side, the supernumerary ganglion, was only two lines long, and one thick. The semilunar ganglion of the same side was indurated, and redder than usual.

§ 30. *The greater splanchnic nerve,* penetrated into the abdomen, and was immediately lost in a large ganglion, called *semilunar,* but often of an irregular, variable form, situated upon the crura of the diaphragm, between the capsula renalis, and the aorta. Instead of one large ganglion, we frequently find three or four nervous enlargements, connected by branches of considerable size, so that the congeries of ganglia, represent a species of islands. In a case detailed by Wrisberg, the splanchnic nerve was immediately converted in an inextricable and almost indescribable manner, into a purely nervous network, in which eleven smaller ganglia, could be counted, spread out in a broad surface. Whatever is the arrangement of these enlargements of the splanchnic nerve, there is always a connection through the medium of transverse branches, between the two larger ganglia of each side, which forms that singular and intricate network, called the *cæliac* or *solar plexus,* because branches emanate from it into different regions of the body, like rays from the sun.

The organs which receive branches from the solar plexus, are the diaphragm, stomach, liver, spleen, small and large intestines, kidneys, suprarenal capsules, and the spermatic vessels in both sexes. For all these nerves there is one general and invariable law, that their branches always accompany the arteries.

§ 31. The diaphragmatic nerves forming the *phrenic plexus,* proceed from the superior part of the solar plexus, a long the crura of the diaphragm, with the great or inferior phrenic artery

and terminate finally in the fibres of the muscle, in conjunction with the branches of the phrenic nerve.

§ 32. The *gastric plexus*, arises from the middle and superior part of the solar plexus, where the two semilunar ganglia, are connected together through the medium of transverse branches. The branches which form this plexus, surround like a nervous network, the coronary artery of the stomach, and as they accompany its posterior branches meet with the par vagum of the right side with which they are connected in a manner to be described below. By this union the gastric plexus is rendered larger, and more remarkable; eight or ten small nervous trunks proceed from it, creeping among the muscular fibres of the stomach by which they are at length concealed, until they reach the middle region of the stomach, and are finally exhausted in the cellular webwork of the villous membrane.

The remaining gastric nerves, are disposed in the following manner, according to the observations I have made.

The left par vagum, which is anterior to the stomach does not communicate at all with the solar plexus; but passing along the lesser curvature is divided into about fourteen branches, spread upon the anterior face of this organ, towards its inferior curvature, where having become very small, they disappear in the cellular membrane which connects the muscular and mucous coats. No branches appeared to me distinctly to be sent to the fleshy fibres, except in the region of the insertion of the œsophagus, where one branchlet was evidently spent upon the superficial muscular stratum of the cardia.

To conclude, it may be observed generally of the gastric nerves, that in proportion as they are more numerous in the cardiac and pyloric regions, there are fewer to be found in the middle portion of the viscus.

§ 33. The *hepatic nerves*, pass off from the solar plexus in a double series, and according to WALTER may be divided into two secondary plexuses, *anterior* and *posterior*.

The *anterior* coming from the solar plexus, and chiefly from the left semilunar ganglion, and right gastric branch, accom-

panies the hepatic artery, consisting of about seven thick round strong and reddish branches, two or three of which are connected with the right semilunar ganglion.

Before these branches, properly called the nervi comites of the hepatic artery, reach the liver, a fasciculus of five or more branches from this plexus, descends with the right gastro-duodenal artery, to the pancreas and duodenum.

Of the nerves properly called hepatic, one conspicuous trunk divided in three branches, extends to the ductus choledochus, upon which it is spent, whilst the remainder, passing through the portæ of the liver, follow the branches of the hepatic artery, to the third or fourth division, and at length disappear in the external cellular coat of these vessels. Nevertheless, with the microscope I have detected twigs in the right lobe of the liver at the depth of four inches in the cellular coat of the arteries.

In another beside two branches attending the cystic artery to the gall bladder, I found three provided for the hepatic duct, at the place where it bifurcates in order to supply each lobe of the liver. There were some other filaments appropriated to the biliary ducts, inclosed a little more deeply in the substance of the liver. I found no branch to the hepatic veins.

The *posterior*, arises chiefly from the right semilunar ganglion, and accompanies the vena portarum, to which it loosely adheres. There are two or three branches it is said, united with the branches of the anterior hepatic plexus, which are reddish and cylindrical, and enter into the viscus, in a similar way along with the branches of the vessels.

The anterior hepatic plexus is therefore composed chiefly, 1st, of the right par vagum (funiculus stomachicus dexter); 2d, of that part of the solar plexus which is derived from the left semilunar ganglion; and 3d, partly of filaments from the right semilunar ganglion.

The posterior hepatic plexus is formed almost entirely from the right ganglion.

It is known in a general way, that the nerves distributed to the liver, belong *principally* to the arteries which they accom-

pany with their branches. In regard to the vena portarum, I had long considered it doubtful whether that vessel received any nerves *peculiar* to itself. I had frequently followed the branches of this vein as far even as the obtuse margin of the liver, but could never detect any nervous meshes about them, or any especial filaments of their own. However, by diligently investigating the subject, I discovered in the right lobe of the liver, three small branches from the anterior hepatic plexus attending the right branch of the vena portarum, each of which being divided into three or four filaments, proceeded into the external cellular coat of the vessels, and after a course of an inch disappeared from view.

§ 34. The intertexture of the nerves of the spleen, or *splenic plexus*, is evidently composed of two nervous fasciculi, one of which is a branch from the right par vagum, and the other proceeds from the left semilunar ganglion. The right ganglion has no branch connecting it with the splenic artery.

These two fasciculi, connected by anastomosing filaments, surround the splenic artery with a network, which loosely embraces the tunics of the vessels.

When arrived at the fissure of the spleen (hilum lienis) two nervous filaments accompany each branch of the artery.

They do not, however, proceed beyond the second division but deserting the arteries, bury themselves in the parenchyma of the spleen. Some finer branches pass under the outer membrane of the spleen, and disappear there.

The finer filaments of the spleen, appear to me in all respects like those of the other organs. The veins get no nervous filaments.

Numerous firm, though very fine filaments descend from the solar plexus to the subjacent *pancreas*. Those for the head of the pancreas, may be traced from the right semilunar ganglion; and those which belong to the body of that gland from the left ganglion, about the middle of the splenic plexus.

§ 35. A plexus now arises more remarkable than all the rest, which, surrounding the superior mesenteric artery attends its

numerous branches, and is bestowed upon the small intestine, and part of the large. It is named from its situation and distribution, the *superior mesenteric plexus.*

The nerves which form this plexus have a triple source. 1st, from the right semilunar ganglion, which distributes five nervous farciculi to the trunk of the superior mesenteric artery. 2d, from the left semilunar ganglion, out of which seven fasciculi, at least proceed. 3d. From a branch, sent off from the right par vagum. This branch no one yet to my knowledge has described, though it is very conspicuous when the stomach is removed and the trunk of the right par vagum is followed with care, which should be left intact. This fasciculus is then seen to extend straight downward from that trunk, and adhering slightly to the branches of the pancreas, passes to the arteries of the small intestine and the middle colic artery.

The superior mesenteric plexus itself, sends down a fasciculus at the left side of the column, which passes to the inferior mesenteric artery, and is joined by anastomosing branches, from the renal plexus, and from the trunk of the intercostal: the congeries of all these nerves, has obtained the name of *inferior mesenteric plexus* which will be treated of below.

§. 36. The plexuses next in succession, *renal and suprarenal* can not be directly derived from the solar plexus. But each is immediately produced from the semilunar ganglion of the same side, although some filaments come from the superior mesenteric and cæliac plexuses by which the *renal plexus* chiefly is strengthened.

This plexus is formed on the right side, by nerves emanating from the right semilunar ganglion.

It forms a network with which the lesser splanchnic or renal nerve mixes.

Having made an accurate investigation, I discovered that the branches forming the renal plexus, were six times connected together, or formed six plexuses called secondary whence the

branches attending the arteries afterwards emerged, and passed on in a right line.

When one or two ganglia exist in the renal plexus, the number of secondary plexuses is found diminished.

The branches constituting the first plexus, accompanying the trunk of the emulgent artery, part before and part behind it, having afterwards formed a plexus, two principal nerves attend each arterial division, which they surround with their branchlets, and accompany into the kidney.

No nervous branch is sent to the renal veins, nor to the pelves of the kidneys; but a small firm branch may be distinctly, and constantly observed, given off from the last fasciculus of renal nerves, following the ureter, upon the tunic of which it is spent.

Before the renal nerves enter the fissure of the kidney (hilum renis) some slender branches are sent off which are evidently exhausted in the parietes of the arteries.

We cannot on the contrary follow those branches of the nerves which enter the kidney itself, beyond the third division of the arteries: having become exceedingly minute they disappear in the external cellular coat.

§. 37. Three to four filaments are given off from the renal plexus, which descend with the spermatic vessels and constitute therefore the *spermatic plexus*.

This plexus is the least of all, as it is formed out of a few very fine filaments, one of which extends to the ureter, whilst the others disappear in the cellular net-work which surrounds the spermatic vessels, not appearing in the least to proceed to the inguinal ring or to the ovaria in women: which however is the case as I shall demonstrate below in the organic diseases of the testicles.

WALTER* distinguishes from this superior spermatic plexus, another which he calls *inferior*, and which he derives from the plexus surrounding the aorta, with which the *spermatic ganglia* are intermingled.

* I. H. Walter, tabulæ nervorum thoracis et abdominis, Berol 1783, fol. max. tol. 1. No. 305.

I am well acquainted with the nervous intertexture of which WALTER speaks, and which is chiefly formed by filaments from the intercostal trunk; but it emits no ramifications peculiar to the spermatic vessels.

§. 38. As respects the *suprarenal plexus*, I have enumerated eight nervous branches, which extend to the (right) succenturiate kidney (capsula renalis) three of which proceeded from the semilunar ganglion and five from the renal plexus.

The course of these nerves was in a right line, not divided or connected together by anastomosis, before they entered the gland (capsula renalis;) they did not closely embrace the arteries which they attended, but were very loosely united to their cellular coat.

These nervous branches are generally white, not red nor soft, but quite firm. They are not less in diameter than the arteries themselves; sometimes indeed they seem larger.

There are some things worthy of note, respecting the nervous plexuses of the abdomen as well as the branches of the greater and lesser splanchnic nerves. At present the order of this treatise leads us back to the trunk of the intercostal, where we last carefully examined its course and ramifications.

§. 39. Two splanchnic nerves having been given off, the trunk itself penetrates into the abdomen through its own hiatus between the second and third fasciculi of the crura of the diaphragm. It descends upon the sides of the bodies of the lumbar vertebræ, in a direction towards their anterior part, whence the more remote it is from the intervertebral foramina, the longer are the anastomosing branches, between it and the lumbar nerves: but when it has arrived at the pelvis, it again approximates the foramina of the sacrum, and finally reposes at their margin.

It receives in its course, from each of the lumbar nerves, two or three branches which descend obliquely upon the sides of the vertebræ, and where they touch the sympathetic nerve form small ganglia, generally of a flat compressed figure from which filaments shortly to be described, proceed to the organs.

§. 40. In the pelvis on the contrary, the anastomotic branches of the spinal nerves are very short, and form small round ganglia upon the trunk of the sympathetic nerve.

The two last sacral ganglia are frequently deficient, although the intercostal nerve itself is connected with the fourth and fifth sacral pairs, by a very short and slender branchlet. This nerve as it descends, becomes gradually smaller, and towards the apex of the sacrum, the sympathetic nerve of each side converges towards its fellow, till at length they terminate together. For each nerve ends in a very small ganglion called from its situation *coccygeal*, from which small branches are emitted to the cellular texture in front of the point of the coccyx, or the two ends of the nerves, by converging together, inosculate and form a loop, from the convexity of which some fine branchlets are sent to the cellular texture. The former mode of termination I have most frequently observed.

§. 41. Those branches next claim our attention, which arise from the abdominal and pelvic portion of the sympathetic nerve, and are distributed to the viscera and organs. As the trunk of this nerve escapes from its hiatus in the diaphragm, and is placed behind the kidney, it emits one or more small branches to the renal plexus. Afterwards branches emerge from the lumbar ganglia of each side, which environ the aorta in its descent, and constitutes the *aortic plexus*, which is derived from the class of simple nerves, and does not belong to the most intricate divisions of the sympathetic: but two principal generating branches of nerves emanate from this plexus the roots of which are derived from the lumbar ganglia, one called the *inferior mesenteric* or *meso-colic plexus*, and the other the *hypogastric*.

§. 42. The former having received a nervous fasciculus from the superior mesenteric plexus, entangles itself around the trunk of the inferior mesenteric artery ; some small branchlets then attend each ramification of the artery, sub-divide like the latter and are at length found upon the colon of the left side, and the rectum, while one fasciculus having passed into the pelvis, is immersed in the following plexus.

§. 43. This plexus (hypogastric) having a compound origin from the preceding plexus, from the lumbar ganglia, and from the trunk of the intercostal nerve of each side, is placed like a broad fasciculus between the primitive iliac arteries, descends deeply in the pelvis, and is connected by a few branches with the third and fourth sacral nerves: whence a conspicuous interlacing of filaments arise, which in following the branches of the hypogastric artery extend to the rectum, ureter, urinary bladder, to the vesiculæ seminales in man, and to the uterus and vagina in woman.

§. 44. Into the substance of the uterus whether empty or gravid nervous filaments seem to be very rarely sent.

I examined with the greatest care the uterus of a woman, dead twelve hours after parturition, but in which I found no nerves, from either the spermatic or hypogastric plexuses, although the sanguineous and lymphatic vessels were very distinct. I availed myself of the same opportunity, to examine with the microscope whether any nervous twigs were connected with the tunics of these vessels; but with the closest attention could detect none.

* Notwithstanding the labour that has been bestowed by various anatomists on the *structure of the uterus*, the history of its nerves is still imperfect. It may not therefore be amiss to insert here the opinion of Professor TIEDEMAN of Heidelberg, one of the most eminent of living anatomists, though his opinion is somewhat different from that of the distinguished author of this work. In his *Tabulæ nervorum uteri*, M. T. has enumerated six plexuses, three on either side, supplying the uterus, ovaries, and fallopian tubes. The 1st. is the *spermatic*, descending with the spermatic artery, to the ovary and fallopian tube and sending also a few branches into the uterus, the 2d. the *great superior lumbar plexus or common uterine*, which sends many filaments to the uterus in company with the uterine artery, 3d. the inferior, *lateral hypogastric* which always sends branches to the uterus, vagina, bladder and rectum, in a network around the uterine artery. These numerous nerves of the uterus, are small, soft and reddish, and closely applied to the arteries. On entering the substance of the uterus, they disappear all at once, and cannot be distinguished even with a good glass; they appear to terminate in the cellular or mucous texture, intermediate between the blood vessels and lymphatics, no less than between the fleshy fibres, or even to be converted into these. This anatomist has also established other points of no less importance; thus he states that the number and size of the uterine nerves vary at different periods of life; they are very small in young girls, larger at the age of puberty, and again become very small in old women. He has likewise found by the examination of many women who had died a short time after delivery, that these nerves really become larger and more numerous during the period of utero-gestation, as stated by Hunter.—*Translator.*

CHAPTER SECOND.

Critical observations appertaining to the history of the sympathetic nerve.

§. 45. The cephalic extremity of the intercostal nerve, has recently exercised the vigilance of anatomists.

The Author* of a splendid work in the German Language, describes the sympathetic nerve, as ascending from the cervical ganglion into the carotid canal. Then dividing into two branches anterior and posterior, which effect an anastomosis, through the medium of a plexiform ganglion :

1st. With the deep seated vidian nerve. 2d. With the motor externus (6th pair.) 3d. With the common motor nerve of the eye (3d pair.) The author adds that some twigs are sent to the cerebral carotid which are spent upon its tunics.

Ribes† an adept in anatomical investigations, asserts the same thing, and moreover adds, that a ganglion is sometimes found upon the anterior communicating artery. That contained in the carotid canal, was first discovered by the dextrous Laumonier,‡ and described under the name of the *cavernous ganglion.*‖ From this ganglion two small twigs extend to the third cerebral pair of nerves with which they are united, others are connected with the trunk of the superior and inferior maxillary nerves. These filaments I could never find, although I have seen the ganglion distinctly, of which they speak.

But Ribes, going still further§ in the elucidation of the nerves proceeding from the superior cervical ganglion, says he has seen after he had well washed the brain and vessels, a fasciculus arising from the nervous involucrum of the carotid, which attend-

* *Bock*, Beschreibung des funften Nervenpaars und seiner Verbindungen, mit andern Nerven, etc.; mit Kupfern, meissen, 1817, in fol.

† Memoires de la societe medicale d'emulation, Tom. 8. part 2. p. 605.

‡ This ganglion is denominated by the various names, ganglion of Laumonier, cavernous ganglion, carotid ganglion.—*Translator.*

‖ Journal de medecine, chirurgie et pharmacie, par Bacher, tom. 93. p. 205.

§ Memoires de la Societe medicale d'emulation, vol. 7. p. 97.

ed the opthalmic artery and all its ramifications and penetrated with the central artery of the retina into the interior of the eye. He adds moreover that the opthalmic ganglion receives a filament from the sympathetic nerve, whence arises the sympathy which exists between the retina, and the nerves of the iris.

H. CLOQUET, placing too much reliance * as it appears in the aforesaid observations, has in his excellent work delineated ramifications of the sympathetic nerve to the orbit and interior of the eye, by which a communication is formed between the retina and the superior cervical ganglion.

In the same way he admits a nervous anastomosis between that ganglion, and the opthalmic nerve of Willis or nasal nerve.

§. 46. It is not yet satisfactorily shown that any branches of the sympathetic nerve have been very recently discovered in the carotid canal.

WINSLOW† long since recognised the existence of the *carotic plexus*, saying:—ce nerf (le grand sympathique) "des son entree dans le canal osseux, se divise en *plusieurs filets plexiformes*, qui environnent, l'artere carotide dans le meme passage, et en '*accompagnent les courbures*,' jusqu'a l' entree dans le crane etc."

GIRARDI‡ likewise asserts that the intercostal nerve is contained in the carotid canal, divided into many very soft filaments which adhere to the carotid artery in its course. Two or three filaments he acknowledges as sent to the sixth pair of nerves, and others to the fifth pair.

FONTANA has published a similar description. He admits three orders of branchlets distributed in the carotid canal and appertaining to the sixth pair of cerebral nerves: some indeed surround this nerve under a form of soft membrane: some separate from, but placed near it, pass to the carotid artery: others adhere to it. Finally he found filaments accompanying the sixth

* Traite d'anatomie descriptive tom. 2. p. 689, 690.
† Exposition Anatomique, Traite des nerfs, §. 368.
‡ Desgenettes, Precis d'une dissertation de M. Girardi, et des recherches de M. Fontana sur l'origine du nerf intercostal: Journal de Medecine, Chir. et Pharm. par, Bacher. tom 93. p. 53.

pair of nerves, passing to the opthalmic nerve of Willis and the superior maxillary, to the tunics of the carotid artery, to the pituitary gland, and to the orbit; and five small branches anastomosing with the vidian nerve.

§. 47. My dissections which I began a long time ago and have frequently repeated, have not confirmed the number of branchlets described by the authors above. I have very frequently indeed discovered pellucid filaments of a gelatinous consistence connecting the filaments of the sympathetic nerve with the motor oculi and other nerves; but when examined by the microscope they cannot be considered as genuine nervous filaments. I then became dissatisfied with the mode adopted by those who by dint of washing, strove to evolve and make a discovery of nervous branchlets. For by this method the common cellular texture, is reduced into white shreds, which may be readily mistaken for nervous filaments.

§. 48. I pass on to another question, that of the nervous anastomosis lately detected in the tympanum.

JACOBSON† the celebrated professor of Copenhagen, describes a nervous union between the fifth pair, the glosso-pharyngeal and sympathetic nerves. According to this author, the superficial vidian or petrous nerve when received in the hiatus Fallopii, consists of three delicate filaments. The first, superior is joined to the facial nerve. The middle and inferior which are inclosed in their own canals, penetrate into the tympanum, and belong to the aforesaid anastomosis. The former of these last, descends in a sulcus scooped out in the promontory. This in its course receives the other, or inferior small nerve. "It passes "through its own canal, to the promontory, and then through "a covered way to the branch indicated, with which it is "united. Below this branch another appears, arising from "the deep seated branch of the sympathetic nerve, which pene-"trates into the cavity of the tympanum, over the tunic inves-"ting the carotid canal, and through the osseus lamen, and

* Ibid p. 56, 59.
† Acta regiæ Societatis Hafniensis Medicæ, Vol. 5. Hafniæ, 1818, p. 292.

"passes by a horizontal route in the promontory, to the trunk of "the pneumogastric, with which it is united.

"The trunk thus formed in the promontory, descends, accom- "panied by a small artery, and covered by the membrane, inves- "ting the cavity of the tympanum.

"It gives off a few branches; the superior of which pass to "the membrane, closing the pelvis of the foramen ovale, another, "inferior, to the secondary membrane of the tympanum. Hav- "ing parted with these branches the trunk arrives at the interior "aperture of its canal, and descends through it to a small fossa "where it enters into the ganglion of the glosso-pharyngeal nerve."*

This small fossa is nothing but a groove in the petrous bone to receive the small ganglion of the glosso-pharyngeal nerve;—though it is called from this circumstance, *receptaculum ganglioli petrosi nervi glosso-pharyngei* by *Anderschius*,† which he says degenerates into a narrow canal, containing a small nerve continued into the organ of hearing.

The discoverer adds, that this anastomosis, 1st. is never deficient, 2d. that no anomalous arrangement ever supplies its place and 3d. that it exists in all animals.

§. 49. RIBES,‡ started a doubt in regard to the true existence of these nerves, as discovered by JACOBSON in the Tympanum. Whilst on the contrary H. CLOQUET‖ admits them, though he does not name their discoverer. He differs from him, nevertheless, in his description, as he says that the anastomotic branch of the sympathetic, penetrates through the small foramen of the aqueduct of Fallopius, formed in the tympanum.

In a very recent work, F. H. KILLIAN§ a sedulous investigator

* A good idea of this minute, and intricate part of neurology may be derived from an inspection of the plate of the sympathetic, to which I have above alluded; in that however the mode of description is reversed, this nerve being supposed to originate from the pneumogastric.—*Translator.*

† Fragment. descriptionis nervorum cardiacorum; Ludwig, Scriptores neurologici minores, Tol. 2. p. 115.

‡ Dictionaire des sciences medicales T. 56. p. 115.

‖ Traite d'anatomie descriptive, T. 2. p. 689.

§ Anatomische untersuchung uber das neunte Hirnnervenpaar, Pesth, 1822 in 4. p. 71, et Sequente.

of the human body, has submitted the discovery of JACOBSON to a critical investigation, and from his dissections he has discovered that a fine branch from the glosso-pharyngeal nerve, sometimes passes into the tympanum, terminates frequently in the substance of the petrous bone itrelf, but is never associated with the superficial vidian nerve ; that the hiatus Fallopii is always simple, and never divided into three canaliculi for the reception of three nervous filaments, that no branches from the sympathetic nerve pass into the tympanum, but that a few are distributed to the substance of the bone itself.

§ 50. With a knowledge of these new and difficult disquisitions, I have noted the following respecting the discovery of Jacobson.

An ascending filament of the first cervical ganglion (§. 8.) having originated from the trunk of the sympathetic, previous to the formation of the ganglion, enters its own foramen, at the first plexure of the carotid canal. It passes into a canal which is engraved in the bone.

There as it disappears, it is constantly divided into two diverging filaments, the first of which, the more slender and anterior of the two, penetrates into the cavity of the tympanum above the promontory, and is there joined with a filament from the petrous nerve : the other a little stouter, extends from the osseus canal to the posterior part of the tympanum, and is there connected with another branch from the aforesaid petrous nerve.

From this conjunction a branch arises, which permeates a foramen near the receptacle for the glosso-pharyngeal nerve, with which it is united.

That this description may be better understood, it is well to remember, that all the branches we have indicated, pass through small osseus canals, in the anterior, superior, posterior and inferior parietes of the cavity of the tympanum, with the exception only of one filament from the sympathetic nerve, which passes above the promontory.

We will now describe the canal, situated beneath the aqueduct of Fallopius which receives the inferior branch of the superficial

vidian nerve. It opens into the cavity of the tympanum above the promontory. Then passing backwards in the form of a curve descends upon the promontory near the fenestra rotunda, and divides into two small canals, the first of which extends to a small foramen in the carotid canal, and the other opens at the base of the cranium near the receptacle for the glosso-pharyngeal nerve.

§. 51. HALLER* once saw the whole intercostal nerve continued into the splanchnic, as none existed at the sixth rib; but it was again produced of customary size, from new roots below the seventh rib. BICHAT† assumes this observation which he confirmed, as the principal foundation of his theory, in which he does not consider the sympathetic nerve as a continuous trunk from the head to the pelvis. But WRISBERG‡ has pronounced this observation of HALLER an anomaly, and not at all to be considered as the usual structure; which opinion as the result of much investigation, I would strenuously maintain. I have also the concurrence of the skilful WEBER,‖ who has great doubts of the truth of that observation.

In the tenth intercostal interval, the sympathetic nerve also appears occasionally to terminate.

If there be no continuation of the trunk, it passes over the small head of the eleventh rib, to the twelfth, as is usual in other places. But when a more careful examination is made, its direction is found so changed that the lowest root of the splanchnic nerve as it expands over the body of the eleventh vertebra is the true continuation of the trunk, accompanied by a peculiar branch from the spinal nerve, between the eleventh and twelfth dorsal vertebræ, and afterwards having resumed its route passes onward to the abdomen.

The celebrated PORTAL§ indeed asserts that he has never seen the sympathetic nerve interrupted in its thoracic portion.

* Elem Physiol. tom. 4. p. 261.
† Recherches Physiologiques, sur la vie et la mort, p. 82.
‡ Observat, anatom. de ganglio plexuque semilunari, etc. §. 19. Comment, Gœtting, ann. 1779, vol. 2. p. 102.
‖ E. H. Weber, Anat. comp. nervi, sympath, Lips. 1817. p. 122.
§ Description du nerf intercostal dans l'homme; memoires de l'Institute national, Paris, an XI. p. 188.

§. 52. The nerve called superior splanchnic, also claims our attention for its occasional variability of form, which WRISBERG* found in eight subjects, forming the upper root of the semilunar ganglion.

This nerve arises from the cardiac plexus by three or four filaments: It enters into the thorax with the œsophagus; keeps upon the broader part of the bodies of the vertebræ, frequently imparting a filament to the œsophagus, until it is terminated within the thorax in the eighth nerve, or descending with the aorta into the abdomen, is mingled with the semilunar ganglion or solar plexus.

This nerve which no anatomist has described except LUDWIG, is not considered by WRISBERG himself one of the more constant nerves of the human body, as he sought for it in vain in several subjects.

This observation being admitted, it discloses perhaps the cause why (as the connection with the cardiac nerves in this case is defective) the heart in all individuals is not alike affected by diseases of the viscera in the lower part of the abdomen.†

§ 53. The author above cited, appears to me, in describing the abdominal plexuses, to create as it were a number.—For he describes all the filaments which pass off to the different vessels and organs, as peculiar *nervous* networks.—Thus, for example, he admits *pancreatic*, *duodenal*, *omental*, *cystic*, and *umbilical plexuses*. The last, which is formed of filaments accompanying the umbilical vein, towards the

* Observat. de gangl. plex. semilun. Comment, Goetting, pro. anno. 1779; vol. 2. p. 98.

† When the minute details of neurology, shall have become an object of particular study with the systematic writers upon medicine, we will have much fewer morbid phenomena insusceptible of ready explanation, and the practitioner will be able at once to comprehend many of the peculiarities of disease which have heretofore only been accomplished by the difficult remembrance of heterogenous facts, or the subsequent correction of successive errors. He would thus for instance have no difficulty to understand why the excitation of the heart should early correspond with almost every irritation of the stomach, when he knows the close connexion formed between them by the sympathetic system of nerves, and also why it is so seldom deranged in diseases of the uterus and other inferior organs of the abdomen, between which there is no direct connexion.—*Translator.*

umbilicus, I have never seen, although it is described by the celebrated CHAUSSIER.

As to the omental plexuses, which are composed of branches following the right and left gastro-epiploic artery, I am inclined to believe that they appertain to the vessels, and not to the membrane itself, as Wrisberg* has declared; for if this were admitted, it would follow, that the peritoneum, which all physiologists consider insensible in a healthy condition, received many, though minute nerves.†

On this subject, I agree in sentiment with WALTER‡ that the pleura, pericardium, peritoneum, and lymphatic vessels receive no nerves. Contrary to the opinion of many eminent men, that distinguished dissecter could discover no nerves terminating in the lymphatic glands; sometimes, indeed, the small conglobate glands were perforated with one or more filaments; but these passed out immediately, and terminated at some spot near, for which they were destined.

§ 54. Many nervous branchlets proceed from the ganglia directly to other parts, beside the vessels and viscera. Many go to the voluntary muscles, viz: to the longus colli, to the intercostals, according to WALTER, and to the diaphragm. Some filaments are spent in the vertebral ligaments, especially in the lumbar region; others following the ramifications of the vessels appear to enter the bodies of the vertebræ themselves.

§ 55. It behoves us now, to consider more carefully the relation which exists between the nerves and the vessels.

* De nervis viscerum abdominalium. §. 10. Comment. Gœtting. vol. XV. p. 16.

† It is now universally admitted that the nervous filaments accompany the ramification of the arteries, which in the opinion of many physiologists Rudolphi, Ribes, etc. do not reach the serous membrane. This membrane is considered a thin facing, composed of condensed cellular tissue, (a sort of internal epidermis) which is nourished by a kind of imbibition from the vessels of the adjacent parts. When highly and suddenly inflamed, blood vessels and perhaps nerves are extended into it, as lymph is secreted abundantly from its inner surface, and intense pain is developed. The rapidity with which many injuries involving the peritoneum, is repaired by the effusion of lymph, is a matter of general notoriety; the intestines were found by Sir E. Home, completefully glued to the parietal peritoneum, in eight hours by lymph, in which he was able to inject the vessels, and Serres has satisfactorily shown, that the primitive developement of nerves is from their capillary extremities towards the centre.—*Translator.*

‡ Tabulæ nervorum thoracis et abdominies in prætione.

The lymphatic vessels and sanguineous veins receive no nerves, with the exception of the branches of the vena portarum, the pulmonary vein near the heart, and the jugular vein, according to MURRAY*; I have found the nerves of the arteries disposed of in three ways.

1st. The nervous branchlets, at first surround the larger arteries but without adhering to them. Thus the vertebral artery at its origin, is encompassed by many small branches, emerging from the cardiac plexus; but these branchlets are placed so close together, that they seem to constitute an investing membrane to the artery. WRISBERG† incorrectly enumerates this condition of the nerves around the vertebral artery, with the ordinary plexuses.

In the same way the facial arteries are surrounded by nerves, but nevertheless, some fine filaments are spent upon the parietes of their trunks.

2d. On the other hand the relation is different in nearly all the arterial branches which the nerves of the ganglia attend.

For many plexuses not only bind and embrace the arteries, as the ivy does the trunk of a tree, but becoming enlarged in their tunics, penetrate into the organs with these vessels, become soft and apparently pulpy, and vanish in the cellular texture of the artery, or at least disappear to the unassisted eye.

The sagacious LUCÆ ‡ observed that there was no diversity among the greater and smaller arteries in respect to the connexion between the nerves and vessels, which my observations likewise enable me to confirm.

When the nerves are examined with the microscope, an agreeable spectacle is presented to the eyes. For the ultimate filaments of the nerves, running to the arteries, split into numerous fibres which are closely applied together, and form a cellular network, that almost entirely surrounds the arteries. Thence it is

* Observat. anat. de infundib, caus. et variet. quibusd. in part. cervic. nerv. intercost. Ludwig, script. nevrolog. min. t. 2. p. 247.

† Observationes, Anatomicæ quædam circa nervos arterias adeuntes et comitantes, Francof ad Mœnum, 1810; in 4; §. IX. page 26.

‡ Comment. de nervis arterias venasque comitantibus, § 30. Syllog. Comment. anat. Goetting. 1786, in 4 , pag. 64.

that white streaks are seen in it which have a direction like the branches of a birch tree, and are formed evidently from a nervous branchlet. I have very frequently examined the ramifications of the nervi molles which attend the branches of the external carotid artery, and seen the aforesaid observation confirmed. The cellular texture investing the lingual, external maxillary and other arteries, when examined by a microscope of the power of sixty, was nothing but a nervous network, in which the white coloured streaks run in the manner described, and differing wholly from common cellular membrane, [such, for instance as invests the sterno-hyoid muscle.] In a fœtus of seven months I followed a soft branchlet arising from the superior cervical ganglion, which extended to the external carotid, by the aid of a microscope into the cellular texture of the artery, and saw it divided into seven fasciculi or white medullary streaks. What shall I say? The cellular texture which invests the filaments of nerves and is interposed between them, exhibits to the microscope innumerable nervous fibrilli. Hence from the result of experiments I may pronounce without fear of error, that there is a nervous cellular texture given to the arteries chiefly, and to the nervous filaments themselves, separate, and entirely different from the common cellular texture as it exhibits longitudinal fibres running in a right line, and too minute for examination.

3d. It became afterwards a question, whether all the nerves disappeared in the cellular coat of these arteries, or whether there were not some which perforated these vessels, and insinuated themselves into their substance.

"It has never yet been shown" says BEHRENDS,* "that the nervous filaments have passed into the substance of the arteries, I have however seen two small nerves arising on the right side from the superficial cardiac (which nerve receives an increase from the middle cervical ganglion) perforating the external coat of the aorta at its arch, before the origin of the arteria innominata and which were exhausted in the middle or fibrous coat; and in

* Dissertatio inauguralis, qua demonstratur cor nervis carere. p. 31.

the body of a fœtus at full time, I discovered very plainly and demonstrated to others, a small branch perforating the cellular membrane of the aorta, near the origin of the left subclavian artery, which was consumed in its fibrous coat. WALTER,* likewise speaks of branches passing into the same tunic, although he considered it muscular. Finally LUCÆ, who has already been cited, has lately described and exhibited in a plate many filaments to the middle coat of the brachial artery.

§ 56. When we attentively consider the distribution of the sympathetic nerve, we perceive a difference deserving of notice, between the exterior or communicating branches, and the interior branches which go to the organs.

The first never encompass the arterial vessels, though they occasionally attend them. Many of them are found without accompanying arteries. I have never seen the arterial branches attended with anastomotic filaments from the cervical and dorsal nerves, etc. (Here we do not allude to the nutritive vessels of the nerves.) These anastomosing nerves, are never minutely subdivided before they inosculate with the intercostal nerve.

The latter, on the contrary, give off branches to the organs which according to the common law accompany and embrace the arteries with their meshes, and adhere to their parietes, whence it is, that some very distinguished men have believed, that the sympathetic nerve is fabricated for the use of the arteries, and have designated it by the name of *vascular nerve.*

The former always have the same character. They vary, indeed, as to length and tenuity; but their internal structure seems to remain the same, as they possess the same colour and density wherever they are examined, in the cervical, dorsal, lumbar or sacral region.

Let us consider on the other hand, the branches emitted to the organs; how variable is their character and arrangement.

In the carotid canal some slender red filaments are found, flat, rather than cylindrical.

* Loco citato.

In the neck there exist first, some thick, red, soft, succulent, and almost pellucid branches, which are succeeded by white and slender filaments.

In the cavity of the chest, the branches preserve a similar character and condition.

But how great is the diversity in the abdomen in regard to the nature of the plexuses, and their relation to the vessels! I have been taught by an attentive examination of the abdominal nerves, that there is a diversity in every plexus, arising from the semilunar ganglia.

The gastric plexus differs from the hepatic; for its branches are white, shining, firm, and conical. Those of the last are more red, succulent, and cylindrical.

The splenic plexus agrees more with the gastric. The branchlets of these plexuses indeed, envelope the arteries, but without closely adhering to them.

The contrary is observed in the superior mesenteric plexus; the filaments of which adhere so tenaciously to the trunk, and the larger branches given off from it, that we cannot without some force pull them asunder; the small branches are likewise so interconnected, that they rather constitute a nervous membrane, as there is a distinct network in the places between them.

The inferior mesenteric plexus adheres less often to its subjacent artery. But it may be observed generally, respecting these plexuses, that the nervous branches are united closely to the trunks only, and the beginning or origin of the branches: to the smaller branches they adhere more loosely, or rather run parallel with them.

A great difference exists also between the mesenteric plexuses, and the renal plexus, which corresponds with the hepatic in this; that its branches are thicker, more succulent, red, and not unfrequently mixed with ganglia, which I have never observed in the splenic and mesenteric plexuses.

The hypogastric plexus in fine appears to me of all the most dry and firm, particularly where the roots assemble from either side, to form a broad trunk, placed in the middle of the sacrum.

§ 57. The ganglia themselves are not every where of the same nature. In each region there is a principal one: in the neck, viz. the superior cervical: in the thorax, the first thoracic: in the abdomen, the semilunar ganglion. These three ganglia differ very much among themselves in regard to figure and density.

The superior cervical ganglion is longer and softer than the rest, and exceeds them in redness.

The first thoracic ganglion, is found harder and less red than the preceding.

The semilunar ganglion is the densest of all; and in variability of figure is different from the rest. At one time it is observed perforated with foramina, at another divided into secondary ganglia, and again, and indeed most frequently, expanded into a plexus, remarkable for its thick branches.

Other dissimilarities to be found in their internal structure I shall indicate below.

CHAPTER THIRD.

Of the Evolution of the Sympathetic Nerve in the Fœtus.

§ 58. In an embryo of fourteen weeks, three inches long, I have found the trunk of the intercostal nerve to be quite conspicuous.

In the cavity of the chest, it was, in some measure, thick and red, as the thoracic ganglia were placed very near each other.

The superior cervical ganglion was well formed—two lines and a half in length, and half a line in diameter. The greater splanchnic nerve formed a very slender thread: the semilunar ganglia were very obscure.

§ 59. A male embryo of five months, six inches long, afforded a very distinct view of the trunk of the sympathetic: it formed an uninterrupted cord from the base of the head to the pelvis. The superior cervical ganglion was rounder, that is, less flat than in the adult; it was three lines long and one thick. The greater splanchnic nerve, distinct, though very slender, had three roots.

The right semilunar ganglion, which was small and inconspicuous, compared with the superior cervical, was neither branching nor round; but obscure, shrivelled, and scarcely half a line long: it adhered to the neighbouring parts, capsulæ renalis, vessels, &c.

The second and third cervical ganglia were not visible. I know not whether they were deficient originally in that case, but they were certainly not yet formed.

The thoracic ganglia, except the first, formed small nodes about half a line in diameter.

§ 60. In an embryo of six months, the superior cervical ganglion, was five lines long, one line broad, and of a red hue; it gave off some slender filaments, but not soft and semi-pellucid, as in the adult, and much less thick. The third cervical ganglion was one line long, and sent off two very delicate branches for the formation of the cardiac plexus.

The first thoracic ganglion, a line and a half broad, and three lines long, was red, and contributed four filaments to the cardiac plexus. The trunk of the sympathetic nerve formed a firm cord in the neck, the third of a line in thickness. In the chest this trunk appeared thick, succulent, and flat, on account of the thoracic ganglia being a little elongated, and approximating each other very closely. In the intervals of the ganglia, the trunk of the sympathetic nerve was two thirds of a line thick. The splanchnic nerve, firm, though slender, had three roots. It terminated in the right semilunar ganglion, which was a little elongated, and increased by vessels to half a line in thickness. The renal nerve was very distinct.

§ 61. A male fœtus of seven months, weighing three pounds, sixteen inches long, supplied me with the following facts, which deserve to be noticed.

The first cervical ganglion, was eight lines long, and one and a third of a line in thickness: a soft red branch, half a line thick, proceeded from it to the external carotid artery. The middle cervical ganglion, a line and a half long, and two thirds of a line in diameter, gave off the principal cardiac nerve.

The last cervical ganglion, which was situated very near the first thoracic, semi-pellucid and half a line thick and one long, sent off a delicate filament to the œsophagus.

The cervical portion of the sympathetic nerve, was in general large and red, and if I may so speak, well expressed.

The thoracic ganglia were so near together, as to form a broad nervous trunk. But they were whiter than the cervical, and as shining as aponeurotic fibres.

The greater splanchnic nerve arose plainly by three roots, from the eighth, ninth, and tenth thoracic ganglia, and terminated in the round semilunar ganglion, a line in diameter.

In the pelvis, also, the trunk of the sympathetic nerve, as well as the lumbar ganglia, appeared red.

I will state in passing, that this fœtus which was born of a phthisical mother presented a singular spectacle; after seven hours of existence, protracted with respiration and cries, the

lungs were still so dense, that when divided in small pieces, they sunk in water; did not crepitate when handled and dissected, nor could a bubble of air be detected in the bronchial vesicles, by the microscope. My surprise was increased when I saw all the fragments of the lungs, which had been thrown into water with the liver and spleen, and sunk with them to the bottom, floating nine hours afterwards upon the surface, while the abdominal organs remained below.

§ 62. In a fœtus of eight months, I found the superior cervical ganglion, five lines long, one and a half broad, red and consistent; and the middle cervical ganglion, one line broad and red.

The intercostal nerve in the lumbar region, was one line broad, red, and formed as it were, a very long ganglion. The greater splanchnic nerve, which was distinct but slender, terminated in the less perfect semilunar ganglion.

The superior cervical ganglion, gave out the laryngeal nerve on the left side in that subject, but not upon the right.

§ 63. A fœtus at full time afforded me the following account of the distribution of the intercostal nerve.

Four white and slender filaments, but not soft, proceeded from the superior cervical ganglion, which was eight lines long and one and a half thick, to the branches of the external carotid: a fifth filament descended in the direction of the thyroid gland, and was spent in the crico-thyroid muscle. The inferior cervical ganglia did not exist.

The thoracic ganglia, twelve in number were well formed. The first was united to the second, and then presented a longitudinal diameter, of five lines and a half. The diameters of the remainder averaged a line: they had a reddish colour, and nearly all received two anastomosing branches from the costal nerves. The trunk of the intercostal nerve was a third of a line thick, in the intervals of the ganglia, and showed no interruption between its thoracic and abdominal portions. There were four lumbar ganglia, of which the second was a line and a half more in diameter than the rest. Two sacral ganglia only were to be found. The intercostal trunk, near the sacral foramina, was connected

with the nerves by the aid of delicate filaments, without any intermediate enlargements: This nerve was finally connected at the superior part of the os-coccygis, by a minute filament in anastomosis with the nerve of the other side: the coccygeal ganglion did not exist.

Four filaments arose from the thoracic ganglia, which attended the intercostal arteries and terminated upon the aorta.

The greater splanchnic nerve of the right side, arose by four roots from the seventh, ninth, tenth and eleventh ganglia: the left had three roots only.

The lesser splanchnic nerve proceeded by a single root from the twelfth ganglion.

The semilunar ganglia were small, compared with the other ganglia of the sympathetic nerve.

Upon the left side of the same fœtus I also found a branchlet from the superior cervical ganglion, which terminated in the crico-thyroid muscles, after having given off filaments to the thyroid gland.

§. 64. It follows from the aforesaid observations, that in the embryo the sympathetic nerve is found distinct; that the trunk included in the cavity of the chest is thicker than its due proportion, in consequence of the ganglia being located so near together: that the ganglia are perfect, particularly those with which the trunk itself is marked; that these ganglia are of the usual colour; that they are apparently longer and more developed in the fœtus than in the adult, with the exception of the semilunar ganglion which is not evolved to the same extent as the rest, but becomes by its growth important, compared with the other parts of the ganglionic system; from which in respect to physiology it will follow, that the functions of the abdominal organs, are either previously more feeble, or act with less energy than the other viscera of the embryo.

§. 65. It is worth our while to enquire how the sympathetic nerve is constituted in fœtal monsters.

I have learned in investigating this subject, that this nerve is well formed in all its parts, provided the fœtuses do not differ too

much from the human form. Thus in a full grown acranial fœtus with a double hare lip, the two sympathetic nerves were complete in all their parts. I observed the same in a male fœtus of eight months, destitute of cranium and brain, the cerebral nerves of which were well formed, and adhered to the dura mater investing the base of the cranium.

§. 66. Another male fœtus, of nearly eight months gestation a foot and six lines long, exhibited the following, deserving of notice.

In place of cranium, there was a remarkable sac hanging backwards, which when cut, presented beside a particular substance, (which was perhaps cerebral and was almost fluid) a fungous excrescence, seven lines in length situated upon the sella turcica. There was no christa galli: the left part of the nares was deficient, but in its place there was a proboscis as it were eight lines long and four broad, formed solely of the skin and cellular texture, pendulous from the root of the nose, and perforated by a canal which had its termination under the cribriform lamina of the ethmoid bone. There was no vestige of eyes, muscles or nerves; the orbits indeed existed, but they were closed by the palpebræ and filled with cellular tissue. The lingual branch of the inferior maxillary nerve, and the hypoglossal nerve were deficient, but the sympathetic nerve which was larger than usual, supplied the tongue and its muscles with branches from the superior cervical ganglion: nevertheless the distribution of the great intercostal nerve was not different from usual. No thyroid gland existed in that fœtus. The left testicle was contained in the scrotum; the right, provided with its gubernaculum, was as yet concealed in the abdomen.

§. 67. I dissected the body of a full sized acranial fœtus which was as large and fat as any I have ever seen. It weighed eight pounds and a half, was eighteen inches long, and eight inches and eight lines in its humeral diameter. The circumference of its chest was thirteen inches; and of its abdomen eleven inches nine lines; the diameter of its buttocks was six inches. In the place of brain there was a soft tumour, covered by a thin epider-

mis, adhering loosely to the base of the cranium, and divided into two lobes: It was two inches and nine lines in diameter and nineteen lines high, and formed partly of reticular texture not unlike the spongy substance of the corpora cavernosa, and partly of cysts. It was filled with watery blood. The optic, trigeminus, glosso-pharyngeal, par vagum, and hypoglossal nerves were all present: but all these nerves began by a slender and loose connection at the base of the cranium. From the medulla spinalis, which appeared to me smaller, and embraced by denser involucra than usual, large nerves were given off. The great sympathetic appeared as usual, every where perfect, and well developed.

§. 68. I made the same observation in a female acranial fœtus in which the nostrils were present, and a single central eye like that of a Cyclops; the brain was composed in the following way. The cerebellum and medulla oblongata, presented the usual appearance, but in the place of brain there was a round pisiform medullary nucleus, with an umbilicus, on its upper surface, and giving off from its lower, two slender optic nerves, to the orbit; these were united together and terminated in the bulb of the eye, which seemed blown into a double ball. All the cerebral nerves were present except the olfactory.

§ 69. I traced afterwards more carefully the trunk, ganglia and branches of the sympathetic nerve in a male fœtus, which was without cranium and cerebrum.

The base of the cranium which was formed in that subject of the petrous, and a little of the squamous portion of the temporal bone, and the sphenoid bone, was covered only by a hairy skin. No vestiges of nerves were found in the base of the cranium except the optic, which seemed to have a slender beginning at the sella turcica. In the petrous portion of the temporal bone, there was no auditory meatus.

The medulla spinalis, was attenuated and apparently atrophied. From the eighth dorsal vertebra to the first lumbar, the spine was bifid, in which space the dura mater investing the medula spinalis appeared naked. The duodenum in the left hypochondriac

region, was dilated into a large cul-de-sac, and concealed under the transverse colon; thus the intestinal canal was completely interrupted.

The jejunum arose by a slender commencement from the mesentery. The capsulæ renales were quite small, and a few lines distant from the kidneys. The rudiments of the testicles were found in the abdomen. The penis was imperfect, small, and open from the mouth of the urethra to its root; it was surrounded by a fold of the skin, which being slightly cleft at its inferior part, presented somewhat the appearance of the labia vaginæ.

§. 70. Dr. CAYRE,* in the bodies of nine idiots which he dissected, found the nervous ganglia belonging to the sympathetic nerve, well formed, whilst the cerebral and spinal ganglia were shrivelled and apparently atrophied. All the facts I have discovered, tend to the support of this observation.

I stated in the preface of this work, that the cadaver of an idiot would be a very fit subject for the dissection of the intercostal nerves, on account of their better developement, and I have noticed in the body of a male idiot, the occurrence of an extraordinary ganglion (§. 29.) in the greater splanchnic nerve.

§. 71. In old age the ganglia appear more pallid and less succulent than in youth. I observed this in the body of a man eighty four years of age, in whom the distributive branches of the ganglia appeared to me less numerous. The renal plexus for example, had only a few constituent branches, and those more withered and dry than usual. LUCÆ†, has made the same observation.

* Nouveau journal de medecine; t. 4. p. 40.
† Loc. cit. §. 32. p. 32.

CHAPTER FOURTH.

Interior structure of the Sympathetic Nerve.

§. 72. In investigating the internal structure of the sympathetic nerve, let us consider separately the parts of which it is composed. We shall treat therefore of the trunk, branches, ganglia and plexuses.

§. 73. Under the denomination of trunk, I understand that funicle extended between the head and the pelvis, reposing on the bodies of the vertebræ, endowed with ganglia, having communicating branches with the spinal nerves, and sending out a great many ramifications to the organs. This nervous cord a long time preserved its dignity of character, and was considered by all cultivators of anatomy and physiology, as a perfect trunk, until BICHAT, overturning entirely the received doctrine, considered it as only a communicating branch, passing from each ganglion; whence it would follow that in the place of trunk there would exist as many short anastomotic branches as there are ganglia.

§. 74. As I am in favour of the ancient opinion, I will detail the reasons which induce me to defend it.

1st. In the twenty four years, which I have given to the study of anatomy, I do not remember to have ever seen the intercostal nerve interrupted, either in the thorax or any part of its route. I have sometimes known its mere direction to change so much that I should have considered it interrupted, had I not examined more scrupulously into the subject.

2d. I have examined attentively the trunk of the intercostal nerve, from its exit at the superior cervical ganglion, to the fifth thoracic, and having analyzed it by maceration, distinctly seen that the trunk passing over from the middle and last cervical ganglia to the first thoracic, was there mixed with many filaments from the last, and was received by the second thoracic, at its internal side ; afterwards it passed on to the third and fourth ; and

finally united in them, with other filaments, so that it always occupied the internal side of the ganglia. In another instance in which I subjected the trunk of the sympathetic nerve, in a similar manner to dissection, I was confirmed in the truth of this description by my observing a similar structure of this nerve, which I had examined from the first thoracic ganglion to the second sacral.

There is therefore no interruption in the trunk of the intercostal nerve, in the cervical region, nor in the superior part of the thorax; but the delicate filaments which compose the trunk, pass by the ganglia, without any rupture in their course.

§. 75 But this trunk is similar in its formation with all the other nerves, cerebral and spinal. They are all formed of filaments in proportion to their size, arranged in juxta position, but which when separated with the edge of a scalpel, are found so interconnected, as to constitute a perfect network, or a true plexus similar to those which we find in the median nerve, cubital, &c.

§. 76. The branches of the trunk of the sympathetic nerve, are formed in the same way. BICHAT* indeed thinks that the nervous branches of the ganglionic system are of a two-fold character, that *some* (I suppose those which communicate with the cerebral and spinal nerves) are of the same nature as the cerebral nerves in regard to color, divisibility, and composition, which is of medulla enclosed by neurilema, and that *others*, on the contrary (to wit, those proceeding from the ganglia) are soft, slender, cineritious, indivisible, and varying in regard to their formation, from medulla and neurilema.

SCARPA†, maintains a different opinion; to wit, that the ultimate nervous filaments do not differ from the larger nerves except in being slender and delicate, and that they as well as those which proceed from the ganglia, consist of cords composed by the reunion of other nerves.

§ 77. My own observations do not coincide with this opinion of BICHAT. The splanchnic nerve, which is certainly derived from

* Anatomie generall. t. 1. p. 240.
† Annot. Academ. L. 1. c. 4. §. 2.

the ganglia, sometimes begins to expand into the form of a fascicle before its entry into the semilunar ganglia, of which it is easy to divide and enumerate the filaments that compose it.

The smaller branches may be separated in the same manner into filaments. I made an experiment on the hepatic branch, which I unfolded into a plexus in the same manner as practised in the cerebral nerves.*

But the branches of the mesenteric plexus, when examined near the intestines form an exception to this rule. I selected a branch from an infant of five years, which I was unable to reduce into elementary fibres, or to discover in it with a glass magnifying sixty four times, more than a single thread which was not compounded of smaller filaments but formed a single cord in the middle of which appeared a white medullary streak, inclosed by a transparent membrane. I will remark here in passing, that I have proved by repeated observation that the ultimate filaments of the nerves do not solely consist of neurilema, but likewise contain true medulla.

§. 78. We will begin the history of the *ganglia*, by describing their involucra; and afterwards proceed to their interior structure.

The ganglia, and the nerves which belong to them are invested by a double involucrum.

The external consists of fine but loose cellular texture, which connects the ganglia to the neighbouring parts, and aids in the distribution of the sanguineous vessels of the ganglia; sometimes it contains a yellow gelatinous humour; and sometimes is filled with adeps.

The *second* membrane which likewise seems to be cellular adheres more to the substance of the ganglia, is exceedingly thin, and steeped in a humour exhaled from the juicy ganglia. This membrane invests the nerves, sent off from the ganglia, and particularly the trunk as it emerges from them: thus for instance the

* In plate II. is a representation of this branch; Fig. 1. as it appears in the natural state without preparation; Fig. 2. unfolded into a plexus, and magnified to twice its natural dimensions by the microscope.

intercostal nerve, as it descends from the superior cervical ganglion, receives an external tunic which completely encloses it.

I would however remark that this arrangement of the involucra is only found to the full extent described upon the superior cervical ganglion, but that it exists also upon the succeeding cervical ganglia; less evidently upon the first thoracic, and is entirely deficient upon the larger ganglia interspersed in the solar plexus. The semilunar ganglia are encompassed by a delicate cellular texture beneath which the naked substance of the ganglia is found.

§. 79. The involucra of the ganglia being removed a soft succulent substance of a yellow or ash colour is to be seen which fills the narrow space between the nervous filaments, and by the aid of which the nervous intertexture is expanded into a tubercular ball.* This substance which is considered by anatomists and physiologists of the same character as the brain, is nothing according to the celebrated SCARPA, but a vascular tomentose structure, abounding in mucilaginous fluid. An observation of the same author, that the humour itself is found to differ in different subjects corroborates this opinion. Thus it is found thin and aqueous in the hydropic, oily in the corpulent &c. Of the conclusions to be formed in relation to this subject, I will shortly speak.

§. 80. By the maceration of the ganglia for a sufficient time in limpid water the whole tubercular mass is converted into flocculi, which never degenerate into cellular texture, or divide into a network.

There appears on the contrary, a series of nervous filaments arranged in a certain order, as is seen in the superior cervical ganglion, the slender filaments of which pursue the same course, and are nearly all extended in the length or axis of the ganglion. But the case is different in regard to the more compound ganglia, whose branches are distributed to the different regions, as for example in the inferior cervical and first thoracic.

* Winslow, Traite de la tete, § 25; Johnston, Essay on the use of the ganglions of the nerves; Winterl. dissert. prop. Nov. Inflamm. theor.

In these the fasciculi are soft, and proceed in various directions, part decussate, part diverge to the sides, and part finally sally forth to their different destinations.

The celebrated SCARPA who made a most careful examination of the ganglia, taught that all the nerves entering the ganglia were interrupted, separated, and afterwards again conjoined, so that each of those passing out was composed of filaments from each of the entering branchlets.

Thus for instance it is supposed, that the soft carotid nerves, given off from the superior cervical ganglion, are not only composed of filaments from the fifth and sixth cerebral, but also of some from the second and third spinal nerves.

The same author afterwards adds, that there is in each ganglia a pulpy substance between the nervous filaments, the use of which is to detain the filaments of the ganglia in their site and order, and to cherish and embue them continually with its oily fluid.

§. 81. Before SCARPA's time J. G. HAASE,* investigated with great care the structure of the ganglia, and discovered by maceration as well as coction that they were endowed with a double cellular covering; that in their interior the minute nerves were reunited and complicated in the manner of a net; that at their lateral and inferior portion the nerves joined at acute angles, and passed out, collected into fasciculi; that they also formed areolæ filled up with cellular texture, the short and slender fibrils of which extended from nerve to nerve and rendered the ganglion hard; and that finally to all these were added vessels, which perforating each membrane were distributed partly to the cellular texture, and partly to the nerves, tinging the whole ganglion with a red colour.

§. 82. In a more recent work C. G. WUTZER† divides all the ganglia into three orders to wit the cerebral, spinal, and those of the vegetative system, all which differ from each other in regard to their structure.

* De gangliis nervorum: Ludwig, Scriptores nevrologici minores selecti. tom. I. p. 74, 75.

† De Corp. Human. Ganglion, fab. atque usu: monogr. cum tab. æn. Berol. 1817, in 4to., p. 49 et seq.

Each ganglion according to this author is composed of two substances; one primary, of a medullary-white: the other secondary, pulpy, cellular, of a reddish-ash colour, now admitted and described by other anatomists, and especially by ALEXANDER MONRO* the Son.

The former is seen compressed into cords and filaments in the same way as in other nerves, and is of the same character: this is proved; 1st by the course of each medullary filament being continued into the ganglia itself; 2d by the external figure and colour; 3d by chemical experiments, in which the medullary filaments of the ganglia are dissolved in a solution of caustic alkali, in the same way as the medulla of the brain. Nevertheless these medullary filaments when they enter the ganglia part immediately with their neurilema.

The latter constitutes a singular elastic cellular texture, with innumerable minute vesicles and cancelli, and surrounding the whole compages of the medullary filaments of the ganglion. This substance, which does not wholly derive its red colour from the sanguiferous vessels, surrounds the filaments in the ganglia of the sympathetic nerve, and is more tenacious than in the spinal ganglia, where it is looser, and is lost sight of. It acquires very great consistency and tenacity in the semilunar ganglia; from which the investigation and anatomical analysis of these bodies is attended with great difficulty.

§ 83. I will now narrate with candour, my own observations in relation to the internal structure of the ganglia.

The best method of investigating the structure of the ganglia, accoridng to RUYSCH, and SCARPA, is by maceration in simple water. Well accustomed to this operation, I affixed the ganglia to a wooden table, and by washing them daily with fresh limpid water, reduced them into tomentose globules, in which the condition of the minutest filaments were best seen, especially when the nerves were thrown upon an ebony plate, which rendered the nervous fibrils more conspicuously white.

* Observ. on the struct. and funct. of the nerv. syst. Edinb., 1743; Chap. xix Sect. 3, p. 52—58.

In this way I examined the trunk of the intercostal nerve, and its series of ganglia, from the superior cervical to the fourth thoracic.

I likewise repeatedly examined the semilunar ganglia in the same manner with great care.*

By this means I discovered that the ganglia were not all of the same character, as to colour, density, and hardness.

The *first cervical ganglion* appeared to me to be the softest of all, most succulent, and of the deepest red-ash colour. It never appeared plexiform, or perforated with foramina.

The *first thoracic ganglion* always appeared harder, less pulpy, of a lighter ash colour, and not in the least red. It is more variable in its form, as I have said above. It is sometimes, also, pierced by a foramen.

The *semilunar ganglia* which have the greatest consistence of all, are variable in their figure, and very frequently perforated with holes, which gives them the appearance of a species of islands: within they are of the same colour as the human skin, or the salivary glands in a state of health.

§ 84. I found in all the ganglia the same gelatinous juice that SCARPA spoke of. I observed the same to be more abundant, but never oily or adipose in hydropic subjects. It occurs most frequently, likewise, in young individuals, and gives the ganglia some pellucidness. It runs, also, through the external and internal branches of the ganglia, so that the filaments of the cervical ganglia, appeared to me very diaphanous in the fœtus, and in individuals who died young.

But it is far from certain that this fluid is a constant phenomenon to be referred with propriety to the normal state of the ganglia. It occurs very rarely in the thoracic ganglia, cardiac and pulmonary plexuses: but more frequently (till a certain age) in the neck, in some of the anastomosing branches of the spinal nerves, and in the nerves constituting the carotid plexus, of which those called *molles* seem long to retain the same juice.

* Fig. 2nd, plate III, is a representation of the semilunar ganglion, as it appeared when dissected and spread out under the microscope.

Although this juice is less usually met with, and less referrable to the natural structure of the ganglia than Scarpa thought, yet I admit with him, that it serves chiefly to nourish and anoint the nervous filaments; but it should not be considered analagous to the cerebral substance, as has been done by some anatomists.

§ 85. Though I do not believe that the substance of the ganglia is similar to that of the brain, I cannot deny that I have found two substances in the ganglia, in which I agree in opinion with the distinguished WUTZER.

In the smaller ganglia, for instance, in the middle cervical, in all the thoracic, (except the first) and in the lumbar ganglia, the filamentous network may be more successfully unfolded. I was able to separate each of these ganglia into a plexus, in which the nervous filaments when magnified by the microscope seemed connected together, like white semi-lucid fillets or fascicles. The linear direction and fibrous structure of these fascicles, constituted the essential character of the nerve. Adjoining the white filiform substance of these ganglia, there is another of a cineritious colour, and orbicular figure, tomentose, and irreducible into a plexus, which I consider the second matter, or substance of the ganglion.

In the larger ganglia, to wit, in the first thoracic and semilunar, the greater thickness and density, as well as intertexture of the filaments of the nerves, renders this operation more difficult. Nevertheless after a long and continuous maceration, the filamentous substance within the ganglia, which is evidently derived from the entering nerves, was resolved into delicate white fibrils, between which the cineritious matter of an orbicular or globular form is deposited.*

The first cervical ganglion alone, appears to me to vary from the common rule, as its substance is not divided into filamentous and orbicular portions. That ganglion after thirty days maceration became somewhat softened, but formed for a long time, a

* Fig. 2d, plate 3, let. d, d, d, d, d.

homogeneous mass. When examined by the microscope, it presented to the eye a beautiful spectacle of innumerable delicate fibres, not unlike cotton: but these were not divisible into fasciculi proceeding in different directions agreeably to SCARPA's belief.

In general we may receive this as a constant and well established law, that the larger the ganglia, the less there is of the globulo-cineritious matter;—the smaller, the more of this latter substance exists, which is then of a deep yellow colour.

All the spinal ganglia possess this substance.

§ 86. In regard to the *vessels* of the ganglia, it is well known that they are derived from the arteries and veins of the neighboring parts. Thus, the superior cervical ganglion receives branches from the internal carotid, by the ascending pharyngeal artery and vein, &c.: the middle cervical ganglion from the inferior thyroideal artery: the first thoracic from branches arising from the subclavian: the remaining thoracic ganglia from the intercostal arteries and veins: the semilunar ganglia from the phrenic, suprarenal, &c.

When a ganglion possesses many nerves, which enter or depart from it, each nerve is attended by an arterial and venous branch, that seem to participate in its composition.

In examining into the vessels of the superior cervical ganglion, I perceived a network* situated in the second involucrum proceeding from four small trunks. The smaller vessels which run in the length of the ganglion were nearly all filled with a red wax injection. As is common in other situations we also sometimes find in the ganglia two veins to an artery.

Some other small branches which perforate the second involucrum, were discovered when the substance of the ganglion was separated from its tunics. These at first sight appeared like a red pulp,† which, under the microscope, seemed to have innumerable ramifications in the same direction as the filaments which com-

* Plate I. Fig. 1, let. b, b, b, b.
† Plate I. Fig. 2, let. a.

pose* the ganglion, and on which is interspersed some tomentose-globular matter.†

It is very probable that a small artery and vein, attends each nervous filament as is observed in the larger branches of the nerves; upon which no doubt, the red colour peculiar to the ganglia depends.

The *veins* are somewhat differently circumstanced from the arteries. For the former when examined in the superior cervical ganglion and filled with a green substance appear in the form of a plexus at the superior part of the ganglion, from which many small branches descend, some transversely, while others run in the direction of the ganglion.‡

As to the *lymphatic vessels* I have frequently observed their meshes surrounding the ganglia, especially the first thoracic; but I have not yet been able to fill them with mercury or even to force the latter past the valves into the ganglia.

§ 87. In order to understand more fully the nature of the ganglia, BICHAT instituted various chemical experiments, from which he drew the following inferences.‖

The parenchyma of the ganglia has nothing in common with the substance of the brain. This latter is soft and semifluid, condensed with acids and alcohol, but not changed into a coriaceous substance; whilst, on the contrary, the ganglia are crisped like the solids and acquire the greatest consistence.

By boiling, the ganglia are at first indurated, but in the course of half an hour become softened. Alkalies act with much power upon the ganglia, and gradually dissolve them, but not instantaneously as occurs only in the medulla of the brain. WUTZER§ after having repeated these experiments on a more extensive scale confirms the existence of this difference between the substance of the ganglia and the cerebral mass. It is found also that the ganglia differ from the nerves in the greater abundance of

* Plate I. Fig. 4.
† Plate I. Fig. 4, let. c.
‡ Plate I. Fig. 5.
‖ Anatomie generale, tom. I. p. 221 et 222.
§ L. C., p. 66 et Seq.

animal gelatine; and from the substance of the brain still more, by a greater quantity of gelatine and indurated albumen, and by a lesser abundance of oily and fatty matter.

I have however learned by experiment, that the ganglia, although they resist putrefaction longer than the cerebral nerves, suffer notwithstanding a peculiar degeneration, into fatty matter, called *adipocire.*

I discovered in the maceration of the ganglia that when I neglected for a single day to pour water upon them they soon become dry, nor could I afterwards in any way restore them to their former state of softness; they remained dry and finally changed into adipocire, although they were again placed under water. It required about twenty days for the whole structure of the ganglia to degenerate into this substance.

§ 88. I shall now proceed to the arrangement and structure of the plexuses.

The observations of SCARPA, show that the interlacing of nerves, called plexuses resemble the ganglia so much in structure and function, that the latter might be said to represent a species of plexuses, and the plexuses a species of ganglia. "For in "the plexus says this author, as in the ganglion, the nerves com- "ing by different origins from many places, are united at the "commencement, mingled in the centre, and frequently separat- "ed at their exit into a greater number of filaments."*

The investigations which I have again and again made of the ganglia of the spinal nerves partly confirm this opinion. The ganglia situated in the neck, and the superior part of the thorax are never found to vary from the form of tubercles; but those which follow, begin gradually, to expand and disentangle themselves, so that the lumbar ganglia of the nerves no longer appear as nervous nodes, but perfect plexuses.

It cannot however be denied that there are some ganglia in which the plexuses are defective. First, the intermixture of filaments is much more subtle; then they abound with juice, secret-

* Annot. anat. de gangliis, præfatio, p. 6.

ed undoubtedly by their numerous vessels: but the principal difference between them is in the tomentose matter, which is of a yellowish colour, a little crisped, and does not occur in the plexuses. If the ganglia were nothing but condensed plexuses, and the plexuses but expanded ganglia, they might occupy the same situation, and perform the same offices and functions. Suppose all the ganglia of the body, particularly those of the neck, back and abdomen, by some præternatural power, suddenly transformed into plexuses; would the animal œconomy suffer any change by that transformation?

§ 89. It has been questioned whether in the plexuses, there is a true anastomosis of the branches, as in the vessels, or whether there is a mere conjunction of the filaments without any intermixture of the nervous pulp.

As this subject is placed beyond a shadow of doubt in the nervous loops, I believe the same thing occurs in the interlacing of the plexuses, which in my opinion consist of nothing but small loops; on this account I examined the loop between the right par vagum, and the solar plexus, called by WRISBERG,* *fascia communicans memorabilis* and became convinced from my investigation of the continuous passage of one nerve into the other. For the principal part of the filaments of the par vagum, run immediately into the semilunar ganglion, and vice versa, the filaments issuing from the ganglia, were so continuous with those of the par vagum, that it was impossible to indicate their termination or commencement.

Plate III. figure 3d. is a representation of this anastomosis as it appeared under the microscope, and offers a good illustration of this subject.

Did we wish to consider the gastric nerve as being continuous with the brain, we might with the greatest correctness state that the filaments of the right par vagum, commencing at the brain, descend without any interruption to the ganglia, where they terminate; and that in like manner the filaments of the ganglia as-

* Comment. Goetting. vol. XV. p. 11.

cend to the brain in which they are lost. Hence there is an immediate connection formed between the cerebrum and solar plexus, which in the subsequent part of this treatise will demand more of our attention. Now to return to the proposition, I maintain that the same thing occurs in the smaller branches of the plexuses, where the same anastomosis exists, as in the larger nervous loops, and in the case which I have adduced for example.

SECTION SECOND. PHYSIOLOGICAL.

§. 90. As the intercostal nerve is chiefly remarkable from its multiplicity of ganglia, it is necessary to associate with a physiological treatise upon this subject the opinions held by the most eminent men in regard to the use of the ganglia.

I prefer indeed that the leading opinions of such distinguished men should be first stated, before an attempt is made at their refutation, as in this way more light is reflected upon the opinion which is now maintained upon different and as I think satisfactory grounds.

§. 91. WILLIS* had a general idea of the function and use of the intercostal nerve, much alike indeed that of the present time. He says, namely, that this nerve is the medium of communication between the *conception of the brain* and the *affections of the præcordia*, and also between the *actions* and *sufferings passiones* of nearly all the parts of the body, which belong to the involuntary class; so that it intervenes between each sympathetic condition, and the speediest, corresponding affection: and that these ganglia likewise possess nodes, similar to those on the trunk of a shrubby tree, which serve as a diverticulum to the *spirits*.

§. 92. VIEUSSENS,† like WILLIS, considers the intercostal nerve, as the medium, by which the sympathetic relation is rendered so remarkable between the cerebrum and the viscera of the middle and lower parts of the abdomen; for not only do the various conditions of the brain, differently affect the aforesaid viscera, but vice versa, the affections of the viscera afflict the brain as well as the mind itself. To the ganglia which he generally calls *gangliform plexuses*, he assigns a fermentative nature by which convulsive movements are produced in the muscular fibres.

* Nervorum descriptio et usus. cap. xxvi, Opera Omnia. Genevæ, 1695 in 4to. Tome I. p. 137.

† Neurograph. univers. lib. 3. de nervis cap. v.

I give the opinion of LANCISIUS,* who compared the ganglia with the heart, believing, that as the extreme parts of this system have a central direction, it was intended to assist in the movement of the nervous fluid. He furnished indeed a description of these organs, which agrees better with his hypothesis, than the actual state in which these organs are found.

§ 93. According to WINSLOW,† the ganglia are nuclei, or separate organs of the great sympathetic nerve, which represent as many small brains. The sympathetic nerve itself, which this author first calls by that name, he says does not arise in the carotid canal, but rather distributes branches there which ascend in a retrograde direction, to communicate with the fifth and sixth pairs of cerebral nerves.‡

§ 94. MECKEL‖ explained the use of the ganglia as follows: 1st, That the branches may be divided into a great many of smaller size, and these again into filaments. 2d, That the branches may pass by different directions to their various destinations. 3d, That many branches may be united into one funicle.

ZINN§ maintains the same opinion, and adds that the branchlets entering the ganglia from different parts, are intimately mixed and united together, in which they differ from plexuses, where he believes the branches are only in juxtaposition.

§ 95. JOHNSTON¶ pronounces the ganglia, small brains, composed of two substances, cineritious and medullary, in which beside the minute vessels that serve for their nutrition, there are nervous fibres which lose the rectilinear direction, and undergo a new construction of their parts. These ganglia evolve nervous power, and communicate it to the organs in the same way as the brain. Upon their use and functions, this author, likewise, expresses an ingenious opinion: he considers the ganglia as the

* Epist. ad Morgagn. de gangliis nervorum.
† Exposition Anat., Traite des nerves, § 364.
‡ L. C. § 357.
‖ Memoires de Berlin, annee 1749, p. 91. § xiv.
§ Ibidem, annee, 1753, p. 137.
¶ J. Johnston, Untersuchungen, uber das Nervensystem; a. d. Engl., von Michælis, Leipzig, 1796. in 8. p. 94.

source and origin of the nerves, appertaining to the involuntary organs. It is doubtless by their influence that the voluntary power is destroyed in parts not subjected to the will; and that the motion of the heart, for instance, and of the intestines is entirely involuntary.

§ 96. According to HAASE* [redacted] e ganglia consists in this, that the nerves in [redacted] may be separated from each other, and after having changed their direction, be divided to the neighbouring parts in the different regions of the body; whence it is that they agree best with the nervous plexuses in functional relations, and that a strong analogy exists between these two kinds of nervous junctions; which is manifest from this, beside other resemblances that small ganglia are frequently interwoven with the plexuses. This author denies that the nerves are united, or sustain a new reticulated composition in the ganglia.

He refutes afterwards the opinion of JOHNSTON, upon these grounds: 1st, That the voluntary muscles, for example the diaphragm, and the other muscles moving the ribs receive nerves, from the spinal ganglia: 2d, That the involuntary muscles, as the stomach, for instance, receive branches from the par vagum, upon which no ganglion exists.

§ 97. SCARPA,† adopting the opinion of Meckel and Zinn, assigns a three-fold use to the ganglia; namely, "of disuniting the nerves and of intermingling and collecting them again into new sets. For they first separate the nerves, which are then of some size, divide them into many smaller filaments, and incline them at various angles, and in different directions, so that they may be considered as arising commodiously from the same portion of the trunk, to be distributed to many parts of the body, which are variously situated. Nerves which have a different origin from the brain or spinal marrow, enter the same ganglion, where they are so much commingled together that each branch in departing is composed of filaments much interwoven together, and derived from all the nerves which penetrate into the gan-

* L. C. p. 75 et sequent.
† L. C. cap. 2. § x.

glion: and thirdly, they finally collect the slender, numerous, soft, and disjoined filaments of nerves, and associate them together in the same trunk, which likewise is rendered somewhat firmer."

Applying this explanation to the course of the intercostal nerve, that celebrated author has demonstrated, that the ganglia of this nerve are so disposed, that in the smallest space, and from a convenient situation they may disperse nervous ramifications with admirable facility, to the parts contained in the thorax and abdomen. He believes, likewise, (which he proves by anatomical demonstration) that each root of the splanchnic nerve, is composed at first of filaments from the intercostal nerve, or of ramifications from most of the spinal; afterwards of filaments from the dorsal nerves, which pass in each intercostal space, from the spine of the back to the thoracic ganglion; and also of filaments from the fifth and sixth pairs which arise from the brain. How very exalted an origin does this nerve possess!

Scarpa was disposed to conclude from his experiments, that all the viscera, as is demonstrated by the ganglia of the intercostal nerve, receive nerves composed of many separate filaments, the origin of some of which may be found in the brain, and some in the spinal marrow.

If confidence be placed in this refined delineation, it will follow, that the ganglia of the intercostal nerve constitute nothing peculiar, and possess no particular influence; but that the visceral nerves emerging from them, emanate from the medulla spinales, and from the fifth and sixth cerebral pairs.

This celebrated author, indeed, by trusting too much to anatomical considerations, seems to me to have adopted an entirely mechanical opinion in regard to the character and function of these nerves.

§ 98. The first who improved upon the doctrine of Winslow and Johnson, and proposed a more physiological view of the sympathetic nerve and ganglia, was the ingenious Bichat, agreeably to whom, the whole system of this nerve, which he ascribed only to organic (or nutritive) life, was nothing else than a con-

series of multiplied centres, from which the nervous power was emitted to the organs. The anatomical difference between organic and animal nerves, according to this author, consists in the following; that these (animal nerves) have but one centre, which is the brain; and those (organic) numerous centres, that is the ganglia: therefore the intercostal nerve is endowed with as many centres as it possesses ganglia. These are interconnected by the aid of branches, and the funicle called the trunk of the intercostal nerve is itself but an anastomosing branch extending between each of the ganglia.*

I have many times remarked that the celebrated BICHAT errs greatly when he considers the trunk of the intercostal nerve as a communicating branch, placed as it were fortuitously between the series of ganglia. I have resorted in this investigation, to profounder anatomical research, in which I have shown, that this funicle either passes over or lies upon the ganglia, without interruption from a single ganglion, or arising from any new source.

Now, in regard to the use ascribed to these ganglia, BICHAT, if I may so speak, has considered them too solitarily and not enough as an integral undivided apparatus; he understood fully the influence and functions of the several parts of this system, but not respecting it enough as a whole, he exaggerated too much the importance of each ganglion. If, in truth, the ganglia be the centres and foci of the nervous power, why, I ask, has nature created so many nervous tubercles, which, as in the hordeiforme ones of the thorax, send absolutely none, or the very finest branches to the neighbouring parts? Where could have been the want of a nervous *laboratory*, when a few delicate filaments are sent to the aorta?. The viscera of the thorax and abdomen are not so distinct from each other, as this theory would induce us to suppose, but are all connected intimately with each other. Let us suppose the ganglia and nervous plexuses are segregated from each other,—no longer united by their peculiar connections. Each organ deriving its branches from these nerves, would act sepa-

* Anatomie Generale, Tom 1, p. 212, 213.

rately, in a way peculiar to itself, having no connection with the system at large. Thence it would follow, that the sympathy of parts would be continually disturbed, and the harmony of functions destroyed upon every occasion.

§ 99. The distinguished REIL* having imbibed these ideas from BICHAT, erected upon them a theory of his own, which I am disposed to consider more at length on account of its very great celebrity.

The sympathetic nerve (according to REIL) constitutes a peculiar nervous system, different from that of the brain, which is best denominated by the term of *ganglionic system*, or *system of ganglia.*

This system is found only in a few orders of animals. It is met with only in those organs called the organs of nutrition. It presides over that function only, by the aid of which is re-produced, whatever is lost and consumed in the operations of life; wherefore, this system is most correctly called the *vegetative* nervous system.

It is the first, therefore, in the scale of animals, begins in the molluscæ, ascending upwards by degrees to man.

In the more perfect classes of animals, it is united in friendly intercourse with the *cerebral* nervous system, or system of *animal* life; but from which it is not produced, and does not emanate. For no nerve arises from another, as the stem of a plant from its root, or branches from the trunk of an artery; but the nerve is formed by a plastic power in that place, where it is found distributed. Hence the term, *origin of nerve,* denotes nothing but its mode of union with its own system.

The cerebral nervous system is formed differently from that of the nervous ganglia. The branches of the *former* converge from the periphery of the body toward the cerebrum, and are inserted into it by their roots, as the roots of vegetables are in the soil: that system has therefore but one centre, which is in the *encephalon.*

* Archiv. fur die Physiologie: Band 7. p. 189.

The *latter* on the contrary is not collected into any centre: it has no single focus of action, but exercises its functions over a wide surface. It connects the organs together in three different modes.

1st. It forms networks around the vessels, which embrace the arteries with their slender and minute branchlets, (as the ivy clasps the stem of a tree) and penetrates with them to the organs. These networks are known under the name of *plexuses*, twelve of which are enumerated, appertaining to different parts. One however is particularly conspicuous, placed in the back part of the epigastrium, and furnished with ganglia, from which branches proceed to the abdominal viscera forming secondary plexuses: this plexus (solar) has a long time been considered by physiologists, as a *centre* or *abdominal brain.*

2d. These plexuses are connected to the brain, and medulla spinalis, by branches which REIL calls *conductors.* Thus the renal nerve and the greater and lesser splanchnic are the conductors of the *plexuses*, and also the cardiac nerves which ascend from the cardiac plexuses to the region of the neck.

The funicle itself which is stretched out longitudinally near the dorsal spine, and known as the *intercostal nerve*, receives these conductors, and connects them with the cerebral system, whilst on the other hand it circumscribes as it were each ganglionic system, and separates them from the cerebral sphere. The two trunks of the sympathetic nerve, united below by the medium of the coccygeal ganglion, or a nervous loop, and above by the brain likewise through the intervention of the fifth and sixth cerebral pairs, form a circle in returning upon themselves or rather an ellipsis which incloses the whole system of ganglia and plexuses. Of the cerebral nerves the fifth, sixth, glosso-pharyngeal, pneumogastric and hypoglossal are immersed in this sphere.

3d. These branches, the conductors of the *plexuses*, appear to form a perfect connection between the animal and vegetative systems; every commotion which the lower viscera suffer, would be conveyed to the sensorium commune, and vice versa, the will would exercise a perfect control over the organs of the thorax

and abdomen, were not these movements intercepted by enlargements in the *conductors*, called *ganglia*.

For the great series or chain of ganglia, with which the principal communicating branch (the trunk of the sympathetic nerve) is endowed, has the following functions: 1st. That the influence of the mind may be broken in the internal organs, which belong to vegetative life: 2d. That the sufferings or internal impressions which are perpetually evolved by the vital process, in the organs destined for nutrition, may be restricted to its own proper sphere, and not transmitted to the brain. Whence it occurs that the mind is unconscious of the changes which occur in the intimate recesses of the viscera.

If for instance, no cervical and thoracic ganglia existed, if the cardiac nerves were directly produced from the spinal and cerebral, the heart might be quieted, at volition alone, like other voluntary muscles; and vice versa, if nature had interposed no ganglia between the abdominal plexuses and spinal medulla, the irritation excited by the aliment in the viscera of nutrition, would be carried to the sensorium, and very often produce disagreeable sensations in the mind.

It appears evident from this, 1st. that the branches existing between the plexuses and medulla spinalis do not effect a complete communication, and should rather be called *semi-conductors*; and 2d. that the ganglia, in the vegetative nervous sphere are the preventive cause of it, like the *isolating bodies* in experiments upon electricity &c. in physics.

When the two nervous systems by which the animal is rendered more perfect, are considered physiologically, each may be esteemed a *sphere of activity* in which the vital actions are differently performed.

In the *animal sphere*, (that is in the cerebrum, the medulla spinalis and their nerves) the determinations of the will and senses when transferred to the common sensorium, become impressions instanter, and as it were at a single impulse.

In the *vegetative sphere*, the nervous energy is slowly, steadily, but obscurely dispersed into the organs. These are connect-

ed together, act according to their peculiar laws, and compose a system, separate from the animal sphere, over which appropriate laws preside.

This system also possesses the faculty of perception; namely, it receives impressions, and reacts upon them; but this perception abides in its own region, and is not communicated to the brain. In a healthy state the system of ganglia, exerts no manifest influence upon the cerebral system, from which it is divided by the *separatory or isolating apparatus*, (the series of ganglia in the sympathetic nerve.)

But the case is different in a state of disease, for when the vital energy is increased in the communicating nerves of the plexuses, the condition of the ganglia is changed; they transmit impressions which the extremities of the nerves in the viscera receive, and become *conductors*, whilst before they were *non conductors* or *isolators*.

This occurs spontaneously in certain genera of diseases of which we shall speak in the third section of this treatise. But there is a certain mode and means discovered, by which the separation between the animal and vegetative spheres may be overcome, and an intercourse instituted between them, or rather the two systems may apparently be united into one. By the influence of animal magnetism which is falsely and to the great detriment of physiology, considered as deceptive by superficial observers, it is most certain that the animal sphere may be extended even to the *inmost* recesses of the organs, so that a free intercourse shall occur between the cerebrum and solar plexus. There exist innumerable experiments which prove that those stunned to sleep by magnetic influence through the epigastrium, that is through the solar plexus as the centre of the vegetative sphere have seen and heard: and why? Because the impediment subsisting between the two nervous spheres, being broken by the magnetic influence, and every obstacle removed, a continuous route is laid open between the seat of the common sensorium and the abdominal plexuses, and if I may be allowed the figure, the cerebrum itself is immersed in the epigastrium.

The physiologists who were best versed in this doctrine, were snatched from the sciences by an early death.

§ 100. Every thing being previously considered, we unite in opinion with Wilson Philip,* who considers the ganglia as organs in which all the nervous power is concentrated, that emanates from the branches which enter them. The sympathetic nerve is nothing but a *diverticulum*, that receives the nervous power emanating from the brain and medulla spinalis, and conducts it to all the parts which are under its subjection. Coinciding in this belief, and with that of JOHNSON and REIL, WUTZER† endeavours to corroborate their opinions upon new grounds, and with experiments upon living animals. For he irritated, as BICHAT and others did, the sympathetic nerve with a mechanical stimulus, and found afterwards no sensation to be produced; whilst on the contrary, a stronger irritant, for instance, the galvanic agent excited vehement cries.‡ This experiment confirms one of the ideas of REIL, to wit, that the ganglia, although they are *separatory* organs, may, notwithstanding be changed into *conductors* under certain circumstances.

The same author moreover believes that the cause which impedes the propagation of the stimulus, applied upon the sympathetic nerve, to the common sensorium, lies in the secondary red cineritious substance of the ganglia, which by encompassing closely the medullary filaments, represses their elastic power.‖

§ 101. The ingenious BROUISSAIS has very lately improved upon the different theories in regard to the functions of the sympathetic nerve.§ He, like the physiologists who wrote before him, considers the intercostal nerve as an especial system, possessing a peculiar sensitive centre, that not only transmits the impressions to the common sensorium, which the actions of the viscera

* Phil. Transact. 1815. p. 1 and 2. (Meckel's, deutsches f. d. Physiol., 2 ter Band, p. 346.) W. Philip, an experimental enquiry into the laws of the vital functions, etc. 2d edit. Lond. 1818. chap. IX.

† L. C. p. 181 et seq.

‡ L. C. § 108.

‖ L. C. § 109.

§ Reflections sur les fonctions du systeme nerveux en general, sur celles du grand sympathique en particulier, et sur quelques outre points de physiologie. Journal des science medicale, 3d annee, T. 12.

excite, but produces in it determinations, which are transmitted by the cerebral and spinal nerves, to the voluntary muscles.

In the fœtus none but the sympathetic nerve is in vigorous action; it exists previous to the secretory and nutrient organs; it sustains the energy of the heart; and breaks in sometimes upon the cerebral sphere, and determines those automatic motions, which the infant when enclosed in the uterus performs with its muscles. Acephalous fœtuses, destitute of cerebral and spinal medulla, and hence wanting the nervous centre, from which emanates the principle of muscular contractions, perform, nevertheless, muscular movements which can be in no other way excited than by the vital influence of the sympathetic nerve, which is joined by anastomosis, with the spinal nerves.

During the extra-uterine life of man, when there exists some intermediate internal sense inherent to the stomach, this nerve forms a remarkable intercourse between the cerebrum, and the viscera of the thorax and abdomen, as is proved by numberless phenomena. Then, as in the embryo and fœtus, it governs the system of capillary vessels, and directs the functions of assimilation and nutrition, through the influence of the vital plastic power, which Broussais calls *vital chemistry*.

§ 102. As the opinions of physiologists have now, in general, been surveyed, it will be proper for me to carefully explain my own in regard to the functions of the sympathetic nerve in a healthy condition. And in order to render the dignity and functions of this nerve the more conspicuous, I will begin with some general principles and observations, with which comparative anatomy has supplied us.

§ 103. No one will certainly deny that there exists in animals a certain central influence, with which the duration of life is intimately connected.

No one, likewise, will deny that this central influence is inherent, not to the osseous, vascular, or muscular systems, or nutrient organs; but to that initial system, which is nobler than the rest, and involves the first character of animality, and after removal of which all power perishes; viz. the nervous system.

We are taught by anatomy that there are nerves in the lowest scale of animals that possess a mouth and digestive organs. Thus for instance, a nervous ring is discovered in the Sipunculi, and Holothuriæ, around the entrance of the œsophagus.* Thus TIEDEMAN in the sea-stars, and SPIX in the Actiniæ, enumerated a few ganglia, from which branches were extended to the other parts of the body.†

In the Ascidiæ (molluscæ acephalicæ) there is a ganglion placed between the orifices of the mouth and anus, from which branches extend to those two regions.‡

In the Mya pictorum beside the nervous ring about the œsophagus, there are found three nervous ganglia.‖

In the molluscæ gasteropodiæ (for example, the Limaces, Helices, Aplysiæ) in the molluscæ cephalopodiæ (for instance Sæpiæ) beside the nervous rings and ganglia destined for the nutrient organs there are other tubercles which represent the brain, (ganglia cerebralia) from which branches proceed to the organs of sense and motion.§

Articulated animals, (for instance, Hirudo medicinalis, Lumbricus terrestris, Ascaris lumbricoides) possess a series of ganglia which have some resemblance to the sympathetic nerve and medulla spinalis of man.¶

In the crustaceæ (for example, Astacus fluviatilis) there is a nervous ring surrounding the œsophagus; above this order the ganglia exist in greater number.

In insects there is found a chain of ganglia described by SWAMMERDAM and LYONET, from whence nerves are distributed to all parts of the body, and which, according to G. R. TREVIRANUS, is analagous to the cephalic and cervical portion of the sympathetic nerve. Hence it follows, 1st, That there is a nervous system in the invertebral animals, which is marked with

* Carus, Lehrbuch der Zootomie; Liepzig 1818, § 65.
† Ibidem § 65. tab. 1. fig. 10. 11.
‡ Ibidem L. C. § 70. tab. 2. fig. 3.
‖ Carus, Lehrbuch der Zootomie, § 72, 75.
§ Ibidem L. C. § 79.
¶ Vermischte, Schriften, anatomischen, und physiologischen Inhalts; 3 ter, Band, p. 58.

ganglia: 2d, That in the lowest order of these animals, the first nervous mass is found which belongs to a nutrient organ: 3d, That other tubercles are speedily added in animals a little superior in the scale, which are not dissimilar to the cerebral system.

§ 104. In animals of a superior order, the motorial and sensorial ganglia of the organs are inflated as it were into one system, the cerebral, in which the gangliform figure disappears; so on the other hand, the organs employed in nutrition are formed into a peculiar system, in which the primitive arrangement and form of the nerves remain, and which (as in the lowest class of animals) closely surround the intestinal canal with their branches.

In fishes also, the sympathetic nerve forms a slender filament in which few or no ganglia are discovered, the Gadus lota excepted, upon the nerve of which a small ganglion is seen communicating with the intercostal nerves.

In the amphibiæ likewise, the sympathetic nerve is found situated near the dorsal spine; it exhibits ganglia in the shell, (*Cuvier.*) In the Batrachiæ, and Ophidiæ it ascends as a very slender filament, into the cranium, in union with the par vagum* whilst it connects together the intercostal nerve.†

In Birds, the intercostal nerve makes its exit from the cranium with the par vagum and glosso-pharyngeal, communicating with the fifth and sixth pairs of the cerebrum; it forms a cervical ganglion which is united with the eighth and ninth.

The nervous trunk is then interrupted in the neck: but in the chest there is found a series of thoracic ganglia,‡ and the trunk of the sympathetic descends even to the caudal vertebræ.‖

§ 105. According to the celebrated Cuvier,§ the sympathetic nerve of animals does not differ much from that of man. On the intercostal nerve of the Simia maimonis, which he dissected, the

* The upper extremity of the trunk of the sympathetic, terminates in this class of animals in the large ganglia of the maxillary nerve.—*Translator.*

† Carus, S. C. § 324.

‡ Branches are sent from these ganglia, in this class of animals, to the blood vessels and viscera, as well as a constant one from each ganglion to the nearest spinal nerve.—*Translator.*

‖ Cuvier, Lecons, d'anatomie, comparee; tom. 2. p. 293.

§ L. C. p. 289.

superior cervical ganglia was seven lines long, and half a line thick, and united with the nervous loop, of the first and second cervical nerves; they gave off the nervi molles for the branches of the carotid artery. The inferior cervical ganglion was a line and a half broad. In all the space comprehended between these two ganglia, the sympathetic nerve was so connected with the par vagum by cellulose webwork, that it seemed to constitute one of its branches. In the thorax on the contrary, and in the abdomen, this nerve is not formed as it is in man.

I discovered a similar disposition in the Simia faunus. But beside this mode of union with the par vagum, I found in the midst of the cellular web, an anastomosing branch between that nerve and the superior cervical ganglion, a line and a half long composed of medullary substance: I saw it distinctly by the aid of a microscope.

I found the intercostal nerve of the Talpa Europea, distinct in the neck and separate from the par vagum. It was distinguished by three ganglia, in the cervical region; the first thoracic was very conspicuous; the remaining thoracic ganglia, were very small, and no branchlets anastomosing with the dorsal could be detected by the aid of the microscope. The splanchnic nerve in this quadruped was of the same thickness as the intercostal itself.

§ 106. It is of great importance that we should know the more general inferences deducible from an attentive examination of the sympathetic nerve in animals.

It was first remarked by MECKEL,* and WEBER,† *that the sympathetic nerve, in relation to the magnitude of the body in vertebrated animals,* is smaller in proportion, as the animals themselves are *lower in the scale.* But of all, the sympathetic nerve of man is the largest, whose cerebrum and medulla spinalis also, exceeds the nervous system of animals in magnitude. But nevertheless as WEBER has informed us, the system of the sympathetic nerve appears more conspicuous, as the animals are younger in which it is examined.

* Deutsches Archiv. fur die Physiol: 1 ster. band. p. 10, 11.
† Anatomia comparata nervi sympathetici. p. 73.

This agrees with my own observations in the human fœtus, in which the ganglia and nervous branches, if we except the semi-lunar ganglia, appear more perfect than in adults.

§ 107. According to a corollary, of the greatest importance, there exists a relation between the sympathetic nerve and the par vagum; to wit, that one may take upon it the functions of the other. For in the inferior vertebrated animals, the par vagum appears to be the more prolific in branches distributed to the intestines as the sympathetic nerve is less; and it is found that in some invertebrated animals no sympathetic nerve exists at all, and in which its functions are performed by the par vagum only. Whence it follows, that the par vagum should be classed under the same law as the sympathetic itself, with the nerves of vegetative life.

In fine, in all orders of animals, the sympathetic nerve is always found in regard to its developement, to correspond with the pre-existing vascular apparatus; which proves that it owes its delicate construction to the wants of the vessels.

§ 108. Every thing that has been said on this subject, having now been attentively considered, it cannot be otherwise than that the great importance of the sympathetic nerve must transcend that of the rest, in the animal organism.

A nervous system which exists in the lowest scale of animals, is peculiar to the nutrient organs, and performs especial functions of its own; which prior to the appearance of the brain, constituted a nervous centre, and which when the cerebral centre is formed in animals, is inter-connected only, and never composes with it one undivided apparatus, but always retains its pristine form and habit; that such a system is endowed with the greatest functional importance is self-evident.

§ 109. On the other hand, those physicians who have proved the most sagacious observers of nature, have declared from the remotest periods, that there is a being and principle (ens et principium) located in the back part of the epigastrium, which they consider immaterial, and which they consider the cause of the phenomena, perceptible in the healthy or morbid condition of the

body. The fact is therefore that doctrines have been taught in the schools, in respect to the *epigastric centre, the power and influence of the diaphragm, the pylorus,* etc. which demonstrate that physicians have indicated the vital phenomena with much exactness, but have greatly erred in regard to their cause and proper location. It is now proved beyond a doubt that the multitude of sensations perceived in the epigastrium, ought not to be referred to the muscles, vessels or gastric organs, but exclusively to the ganglionic plexus of nerves reposing on the cæliac trunk, and called with much reason by WRISBERG the *abdominal brain.*

§ 110. Three cardinal points arise for consideration, in a physiological disquisition upon the nature and character of the sympathetic nerve: 1st. The *forces,* namely with which it is endowed: 2d. The *functions* over which it presides: 3d. The *mode or mechanism* in which its forces are disseminated, and its functions performed.

I. As to the first, the branches of the sympathetic nerve are undoubtedly endowed with the same power as nerves in general; that is from the vital principle, by which tone, strength, and energy are maintained in the organs, over which they preside. It does not seem improbable that the ganglia which diversify the trunk, ought to be considered as the laboratories of that principle which the internal or egredient branches conduct to the viscera and of the nature of which we are entirely unacquainted. I reject the opinion of those who ascribe so mechanical a use to the ganglia, as to consider the intermixture and distribution of the filaments, to be the only cause for which they are created [§ 97.] I showed in the first section of this treatise, that the nervous ganglia are not *reduced plexuses,* for this reason; that beside their delicate branches which are variously interconnected, another substance was discovered in them, which was softer and more tomentose, but did not appear of a fibrous character, and seemed only to be strewed over with the filamental fasciculi.

In the cerebral voluntary nerves as well as in the sympathetic nerve, the nervous principle traverses in both directions; to wit, from the trunk into the branches, and again from the branches into

the trunk; or rather is moved with the greatest celerity. 1st. There is nothing to prevent the numerous nerves which run to the muscular fibres of the heart, stomach, intestines, diaphragm, and anterior muscles of the neck, from having the same relation with these parts, as the nerves emanating from the brain, have with the voluntary muscles. In these nerves, the principle which excites motion, proceeds from the trunk into the branches. 2d. In regard to the similarity of the retrograde motion of the sympathetic nerves with that of the cerebral nerves, we have this, certain, that the numerous branches which terminate in the internal membrane of the stomach, intestines and excretory ducts, which parts they furnish with sensibility, return the impressions they receive (as for instance in the whole tract of intestines) in the aforesaid retrograde manner to a certain centre, as these are returned by the cerebral nerves to the organs of the senses; there is this difference however between them, that impressions, which in the natural state, arise in the viscera, and terminate in the ganglia, in certain cases (which are soon to be pointed out,) ascend into the brain itself, are perceived there, and excite an obscure sensation in the mind.

But the branches of the sympathetic, belong principally to the arteries, which they envelope, while the finest filaments which follow the arterial branches into the organs, are terminated in their external coat. Hence it is manifest that the vessels are primitively constituted under the government of the nerves, and that from them, the force and energy are borrowed, with which they operate in the functions of nutrition and secretion. I suspect also, that the nervous power in organs, which the arteries enter, is diffused, as it were by the cellular structure, in which the nervous filaments vanish: by this arrangement the intimate structure of the organs, is placed as it were, in or penetrated by a nervous atmosphere.

Some observors have subjected the sympathetic nerve to physiological experiments in living animals, in order to investigate its vital properties.

These experiments have been variously tried, especially since

galvanism has been known as an *agent* in physics; but it has not afforded any success to the measures employed by physiologists.

Bichat,* irritated the semilunar ganglia in a living animal, which notwithstanding emitted no sign of pain. I have also made some experiments in younger animals, principally puppies and dogs, which I destroyed shortly after birth by a wound in the medulla spinalis, in order to illustrate the following question; whether the intercostal nerves when excited by a foreign stimulant, do or do not produce a movement in the organs submitted to their control? I carefully destroyed these animals, before I experimented upon the nerves, lest the unnatural movements which the suffering animals should exhibit before life was extinct, might disturb the phenomena to be observed in the nerves. But though every precaution was taken, nothing new was discovered in confirmation of the question.

I applied the wires to the intercostal nerve in these quadrupeds, which was united to the par vagum in the cervical region: I excited from thence the heart, stomach, and intestines: no motion followed in these organs. The heart I confess contracted, but it was spontaneously, and without the application of any irritant; peristaltic contractions of the intestines were also seen to occur, but these were produced by the contact of air, and not by the galvanic agent sent into the nerves.

A rare opportunity was afforded me of experimenting on a human fœtus, the skull of which had been broken, and the brain protruded and almost destroyed during a severe and difficult labour. The muscles quivered, the heart trembled, and the intestines stiffened from the simple contact of the air: but on arming the sympathetic with the wire, and applying galvanism in the usual manner, there was excited no phenomenon in the organs which were capable of motion; whilst, on the contrary, the cerebral nerves when irritated, produced vivid muscular contractions. I know not whether in these experiments, the galvanic irritant

* Anatomie generale; tom. 1. p. 227, 241.

should have produced any effect in the abdominal nerves, inasmuch as these perform the function of secretion, whose action, if any exists, is not perceptible to our senses.

In the mean time, I willingly admit that I have not the same dexterity in physiological experiments which I admire in some distinguished men; and I ingenuously confess that I would place more faith in their observations than my own. A long time ago, however, there were experiments made by celebrated men, which exhibited the influence of the nerves over the heart. WILLIS,* whose observations are conspicuous over the rest, after the section of the par vagum (which is connected with the sympathetic nerve in quadrupeds) saw the heart immediately begin to palpitate, and the larger vessels fill with coagulated blood. BAGLIVI† and LOWER‡ have noticed the same phenomenon. ENS‖ having lacerated the medulla oblongata, remarks, that motions were instantaneously produced in the heart, which increased the force of the pulse; and although HALLER§ has not confirmed the assertion, yet other and more recent experiments support it with much probability. SCHMUCK, FOWLER, PFAFF, LUDWIG, CREVE, and WEBSTER,¶ excited the motion of the heart, in animals both of cold and warm blood. The illustrious HUMBOLDT, also, in the fox, rabbit, frog, lizard, toad,** and gymnotus electricus,†† restored the action of the heart after it had ceased, (that organ being endowed with nerves in these animals) or rendered its contractions more vivid, by galvanic excitement, which he administered with the greatest caution, and in such a manner as to convey it to the heart by animal and vegetable conductors, (to wit, the muscular flesh, phallus esculentus, &c.) as

* Nervorum descript; cap. xxiv, p. 194.
† Opera omn. exper. anat. p. viii.
‡ De corde; p. 90, 91.
‖ De caus. vires. cord. altern; M. 2.
§ Elem. Physiol. tom. 1, p. 464.
¶ Humboldt, Versuche uber die gereizte nerven; und Muskelfaser: 1 ster Band, p. 340, 341.
** L. C. p. 343, 344.
†† Observations sur l'anguille electrique; Recuil d'observations de Zoologie, et d'anatomie comp. par Humboldt et Bonpland, 1811, p. 53. 73.

it was believed that the fibres of the heart, which are easily irritated even by measures not mechanical, would have been injured by a metal.

The same thing succeeded with the Parisian Academicians, who, having separated the heart of a frog from its body, saw it contract and accelerate its motions, from the application of metallic irritation.*

It is, notwithstanding, fully proved by the cultivators of physics, and especially by the learned HUMBOLDT,† that the galvanic agent does not act in the organs of animals, except through the sensile or nervous fibre. Hence the influence of the nerves became apparent, and was declared to exist in the involuntary organs of the inferior order of animals. The Mollusca, (for instance, the limax ater, ostrea edulis, helix pomatia, helix memoralis, sepia officinalis) likewise, when touched with galvanism perceive the stimulation, as we readily infer from their motions, though these animals are destitute of brain and spinal marrow, and have only nerves arranged for nutrition, which emanate from ganglia.

Experiments have shown that in man himself, the galvanic irritation permeates the nerves of the abdominal viscera, excites tormina, and promotes the peristaltic movements of the intestines;‡ whence it may be clearly inferred, that the abdominal nervous system, is analagous to the cerebral nerves, in the perception of stimuli.

From all that has been hitherto produced we are at liberty to conclude, that there is no essential difference between the sympathetic nerve and the encephalic and spinal nerves; but that the two nervous systems are so far distinct, that both are peculiarly situated, according to the different conditions in which they exist in the body.

In the anatomical part of this treatise, it was first demonstrated that the trunk, branches, and filaments of the sympathetic nerve

* Compte rendu, a la classe des sciences mathematiques et physiques de l'Institute national, des premieres experiences sur les phenomenes du galvanisme.
† L. C. p. 262. et sequent.
‡ Ibidem, p. 334, 338.

have the same structure as the cerebral and spinal nerves, the same plexiform division, and when examined with the microscope, the same composition; to wit, medulla and neurilema.

On the other hand, I know from attentive observation, that the sympathetic nerve transmits the impressions it receives, to the common sensorium, in the same manner as the cerebral and spinal nerves. Thus an irritant afflicting the primæ viæ is perceived immediately by the brain, as the following demonstrates; 1st, The tormina occurring in various diseases; 2d, A calculus lodging in the biliary ducts, the pelvis of the kidneys, or the ureters; 3d, An irritant near the hepatic plexus, from which an animal was seen to suffer by HALLER;* 4th, The galvanic agent producing intense peristaltic motion, and secretion of the intestinal fluid according to the experiments of GRAPENGEISER.†

Perhaps my opponents may urge against this view the impotence of the sympathetic nerve in transmitting the commands of the will to the organs to which its branches run. But do there not also exist cerebral nerves in which this power has no existence? The action of the stomach is not subverted by the determination of the will alone, though it receives cerebral branches; the contraction of the diaphragm and abdominal muscles, cannot be restrained in attempts to vomit in tussis, nor in the final period of parturition. The will does not govern the iris, although the movements of the latter depend upon the irritation of the retina. On the other hand, the physiological experiments cited above, prove that the contractions of the heart may be excited by the nerves.

Other arguments will subsequently by adduced which tend to show the analogy, or rather parity between the two nervous systems, in regard to the vital powers with which they are endowed, and the functions they exercise.

For we have discovered [§ 107.] that in the inferior vertebrated, and some invertebrated animals, by turns the sympathetic nerve and par vagum are incomplete, or entirely wanting, but

* De part. corp. hum. sentient. et irritab. opera minora; tom. 1, p. 357.
† Humboldt, L. C. p. 336.

under this regulation that the existing nerve supplies the functions of the absent.

It is likewise established by innumerable observations, that the voluntary nerves may become involuntary, and vice versa; a fact which certainly could not occur if there was a great diversity in their structure, nature, and vital properties. Thus the cerebral and spinal nerves are frequently liberated from mental control, and become obedient to foreign stimuli, as for instance when the muscles of the joints, face &c. are seized with convulsions. Then these muscles are in the same condition, with respect to the brain as the heart: for after this præternatural irritation, they are contracted and moved in opposition to the will, on this account perhaps, that the new stimulus which is more powerful and vivid, overwhelms and deadens the usual and natural irritant. This irritant in the voluntary muscles, consists in a nervous influx; in the involuntary, as for instance the heart, in the contact of blood. Nature seems to have ordained by a peculiar law, that the organs should have their particular stimuli, which they ought to obey and to which they are habituated in health. The heart obtained its stimulus, with the primitive stage of existence; to that it habitually corresponds, and from which it never aberrates except some foreign irritant arising from the viscera of the abdomen, or proceeding from the encephalon (as in mental diseases) produce in it inordinate excitement.

It does not seem to me improbable that a voluntary muscle, as the pectoralis major, for instance, might be changed into an involuntary one like the heart, if it was converted into a hollow muscle, and almost uninterruptedly washed and distended, especially by filling itself with arterial blood; and I am far from disbelieving that it would contract against the influence of the mind. Influenced by these reasons, I find nothing to dispose me to embrace that ingenious doctrine of Reil, [§ 99.] in which an apparatus at one time an isolator, at another a conductor, is assumed as existing in the ganglia, fixed on the trunk of the sympathetic nerve. The following appear to me sufficient for the explanation of the phenomena, perceived in the nerves of vegetative life: 1st. The

forces with which all nerves are endowed, have the same character; 2d. peculiar stimuli, belong to each class of nerves, to which they are accustomed from the primitive evolution of the fœtus.

II. The force and influence of the sympathetic nerve having been carefully examined, it will now be easy to investigate its *functions* and *use.*

1st. *The sympathetic nerve presides over the function of nutrition,* not only because it imparts many nerves to the chylopoietic organs, and sustains their energy and influence, but because it is also distributed to the arteries, which carry the nutrient blood.

Let us suppose the nervous power destroyed in the abdominal plexuses: the tone of the stomach, gastric and intestinal digestion, and the functions of the liver and spleen, would be impaired. That this indeed may take place, is taught by numberless instances of mental disease, which when thrown upon the solar plexus, suddenly disturbs the whole function of digestion.

The abnormal action of the abdominal nerves, exercises an influence over the organs, in regions very distant from each other, from which it is manifest, that the functions of assimilation and nutrition are under its subjection. Recently one of my intimate friends, who is about thirty years of age, after being suddenly terrified by the burning of his house, had his hair to turn white in the course of a few days. Was it not the mental suffering he experienced which by the unanimous consent of physiologists, deranges the abdominal nerves, that in this case produced the change by disordering the force and functions of these nerves? and did not this disordered action effect the nutrition of the capillaries?

Physiologists have long since acknowledged the great influence of the nerves, over the capillary and nutrient vessels. Thus, if it is enhanced, the action of the latter is increased; if diminished, weakened; if utterly deficient, destroyed: hence it is as they are maintained to supply this office, they have not any control beyond it. Is it not then evident that when the nerves are injured nutrition would be frequently destroyed? The experiments of

Dupuy, upon horses, in which the superior cervical ganglia were cut away from either side, furnish good proofs of this;* contraction of the pupil, redness of the conjunctiva (phenomena since observed by F. Petit,) emaciation of the whole body, œdema of the feet, and an universal cutaneous inflammation followed the operation.†

It may be generally remarked of all nerves, of whatever character, whether they belong to the vegetative system or not, that they accompany the arteries in such a manner that the ultimate nervous filaments may reach the capillary texture, and effuse into it their nervous power.

The branches of the nerves appear indeed to terminate in the parietes of the larger arteries, but the cellulose nervous texture [§ 55. No. 2.] proceeds farther, and is undoubtedly intimately mingled with the vascular parenchyma.

To this opinion, which places the dominion of the nerves in the capillary vessels, there may indeed be arguments opposed, proving that the function of nutrition, and reproduction is greatest among those animals (as the Zoophytes for instance) which are either deficient in nerves or are the most imperfectly formed, and with which they ought to enumerate vegetables, which are wholly destitute of nerves.

The phenomena furnished by the classes of inferior animals

* From the results of this experiment, it might be inferred that the integrity of the sympathetic nerve, was less important to the well being of the individual than that of the par vagum. For though the death of this animal was undoubtedly to be attributed to the experiment, yet it did not occur so speedily as it would have done in a like operation upon the par vagum. But let it be considered, that in this case there was but a minute part of the Sympathetic, subjected to the injury, and that too at one of its extremities, the more important portions of this system, lying too deep for experiments by vivisection. When the par vaga are divided, the sensations of the organs, depending upon this nerve, are necessarily destroyed. The sensations of hunger and thirst, are no longer communicated by the stomach to the brain, and if the animal eats, it is mechanically stopped, only by the plenitude of the stomach, without any feeling of satiety. The strongest emetics will no longer produce their peculiar influence on the stomach. In the same way respiration is affected, in this experiment, hæmatosis either ceases, or imperfectly takes place, and the animal may die from the presence of black blood in the heart or brain.

In the experiment upon the horse, death took place by the gradually deteriorating influence of the operation upon the system of nerves which presides over the fountain of life, and not by the collateral aid of suffocation.—*Trans.*

† Journal de Medicine, par Leroux; tom. 37, 1816. p. 340, 350.

have been too incautiously in my opinion, affixed to animals of a superior order. If in them the chemico-vital processes are performed in a simple manner, if for instance the circulation of fluids be performed without a heart, the decomposition of air without lungs or tracheæ, locomotion or any motion, either voluntary or excited by external stimuli, without muscular fibres, &c. it does not necessarily follow that the more perfect animals could exist without these organs. Things can never indeed be compared in which there is such utter dissimilarity.

But what prohibits our discovering in plants, and the simplest genera of animals, a power, analogous to the nervous energy, abounding in their structure in which it is far and widely diffused?

Could not nature bestow the same power which we find in the medullary cords of the higher animals, upon another organ in vegetables and zoophytes, to wit the cellular texture of which they are composed? If some animals and plants can produce motion without muscular apparatus, why should they not have the perception of a stimulant, without the aid of nerves? It was not necessary therefore, that there should be a peculiar organ, in the inferior class of animals, by the influence of which the function of nutrition should be carried on.

2d. What I have said of nutrition in general, holds good in the secretion of the fluids, because the same mechanism supports secretion.

Branches and filaments of nerves, perpetually accompany the arteries, and terminate in their cellular coat. The veins receive no nerves, because they are passive only, in the function of secretion. The excretory ducts on the contrary, are by the unanimous opinion of anatomists endowed with nerves, and which I have seen in the ductus choledochus, ureters, and vasa deferentia (of a morbid testicle.) As this relation exists in the trunks of excretory ducts, there is nothing to disprove that it is not equally the case in their smaller branches: hence a priori and from the anatomical arrangement of the parts, it may now be decided, that the influence of the nerves is felt in the secretory vessels of the conglomerate glands. This property indeed has the following

effects, that the circulation of the blood, be promoted under its influx and the action of the secretory vessels increased.

On the contrary, when the nerves are destined for the excitation of sense or motion, it does not appear, or at least not distinctly that they communicate any *sensibility* to the excretory vessels.

The secretory organs seem to me to enjoy a greater and more exquisite sense, as the mass of excretory ducts is greater in proportion to the other parenchymatous structure of the glands. Thus the testis is the most sensitive of all secretory organs, from its being almost entirely composed of seminiferous substance derived from the excretory ducts: Thus too the salivary glands are exquisitely sensible, because their excretory ducts are large in proportion to the volume of the organs: The kidneys likewise enjoy a lively sensibility, on account of their tubulose substance being a congeries of excretory canals, which also form the chief part of the cortical substance: And on the contrary, the liver is only endowed with obscure sensibility, as all pathological observations attest, because the excretory ducts form the smallest componant part in that immense organ.

There are likewise direct physiological experiments, which sufficiently evince the influence of the nerves over the humoral secretions. The dexterous Brodie,* cut off the pneumogastric and sympathetic nerves, in some physiological experiments upon dogs, into the stomachs of which he had thrown an arsenical solution, which it is well known greatly increases the secretion of the gastric juice. He found the villous tunic inflamed in these animals, though but little abundance of the gastric juice: And why? Because when the nerves were divided the secretory power of the mucous membrane, was utterly destroyed.

As we are considering physiological and pathological phenomena, we will ask if there be any ignorant, that the secretion of fluids in the glands may be increased by the effect of the imagination alone? Who can deny that the maternal milk, the bland

* Biblioth. de medicine britannique, redigee par M. M. Millenger, Mathews et Alexander Brodie, Paris 1814, in 8.

and sweet nutriment of infants, has been suddenly changed by mental affections to an atrocious poison? No other instruments certainly exist but the nerves, by whose aid the psychological irritant can act upon the organs.*

3d. *The sympathetic nerve governs the action of the heart and the circulation of the blood.*

Many branches of nerves that advance from each side of the body to the heart, and are arranged in remarkable plexuses which attend the coronary arteries, do not appertain to the vessels as the celebrated SŒMMERING and BEHRENDS thought, but are evidently chiefly terminated in the muscular substance of the heart. What should we infer from that fact? This certainly! that, the cardiac nerves have the same relation to the fibres of the heart, as the cerebral and spinal nerves with the voluntary muscles. I admit and it follows from the physiological experiments related, that there is some difference between these two classes of nerves, from this reason principally, that the former when irritated by a foreign stimulus do not produce the same vivid movement in the heart, as occurs in the voluntary muscles. But it cannot be in-

* On comparing the results of the experiments made by Wilson Philip, Brodie and Broughton, the following conclusions may be drawn.

"1st. The simple section of the pneumogastric nerves in the neck without loss of substance, and without altering the position of their extremities, does not prevent digestion from being performed; it only retards it in a very evident manner.

2d. The division of these nerves, with a loss of their substance, considerably diminishes the digestive action if the stomach, but does not appear entirely to abolish it.

3d. The division or destruction of the lowest part of the spinal marrow, or the removal of a portion of the brain is productive of the same effects, as to the alteration which food undergoes in the stomach.

4th. Narcotics administered in such a way as to produce coma, equally diminish the digestive power.

5th. Every thing that diminishes the sum of the nervous influence, transmitted to the stomach impedes digestion.

6th. When digestion is completely suspended by the section of these nerves with loss of substance, that action may be re-established by the means of galvanism, and the food contained in the stomach converted into chyme, with almost as much rapidity and to all appearance as completely, as in ordinary circumstances."

Wilson Philip "does not consider the nervous fluid as a vital power," he considers it as similar or analagous to galvanism, which seems thus able to supply its place, either by its own direct effects or by exciting the nervous agent in the organs. "The vital powers he says act through the medium of the nervous fluid upon the organs."—*Translator.*

ferred from this, that that noble organ, is entirely withdrawn from the jurisdiction of the nerves. Does not the fact we daily observe previous to practising experiments upon living animals clearly demonstrate an influx of emotions, in the action of the heart? And whence can that influx arrive at the heart but through the nerves?

We must acknowledge a double property or function in the nerves which run to the muscles; firstly, that they continuously and in uninterrupted course, impress upon the muscles (whatever may be their functions) the tone, strength, vital energy, animal characters and properties of nature: secondly, that they conduct a stimulus emanating from the cerebrum, to the muscular fibre, which excites it to motion.

The former function evidently obtains in the heart, whilst the latter is supplied by the stimulus of blood in the natural state, or by mental affections or other diseases in a præternatural. From which it follows, that the nerves in voluntary muscles perform a *double*, but in the involuntary muscles a *single* function.

It may be asked whether the branches of the intercostal nerve which run to the voluntary muscles, have the same relation with them as the nerves produced from the brain and spinal marrow. What prevents the twigs to the musculi recti capitis, antici majores, longi colli, and the numerous branches to the diaphragm from producing motion, when they are irritated by galvanic or any other stimulus?

Physiologists have doubted the jurisdiction of the nerves over the arteries, chiefly from this reason, that in paralytic limbs the circulation of the blood and the action of the vessels, nevertheless continue.* But the reply to this argument will be easy.

* Of the distribution of these nerves (sympathetic) over the vessels throughout, and their influence upon their function, there cannot at the present time be a doubt. Some even assert that nerves from the cerebro-spinal system also run upon the arteries, and contribute directly to the maintenance of their functions; a fact with which I am not sufficiently versed to admit or deny; but most generally, at least, the influence of this system of nerves over the vessels is greatly modified by being mingled with the ganglia and plexuses of the sympathetic system. I have in several females who had all the genuine symptoms of hysteria such as the clavus and convulsions for a long period, seen, when the disease appeared to be solely confined to the thoracic and abdominal viscera,

1st, If the movement of the blood is continued in the diseased member as before, it depends upon the action of the heart which was not affected with the paralysis; but the capillary circulation is always weakened; as is proved by the atrophy of the affected part, stagnation of the fluids, œdema, diminished heat, etc. 2d, The pulse is generally found weaker and less free in the paralytic than the sound limb. 3d, The experiments upon dogs and rabbits* by EVERARD HOME, show that the pulsations of the carotid artery are increased when an irritant (as pure alkali) was applied to the sympathetic nerve. The arteries beat vividly for three minutes after the contact. But no such effect was produced by the application of the stimulus to the parietes of the vessels or the par vagum: hence it clearly follows, that the force and energy of the arteries, do not depend upon their own irritability, but upon the influx of a nervous principle.

WILSON PHILIP having in a similar manner excited the brain of frogs by alcohol, a solution of opium, and the infusion of tobacco, saw most distinctly that the circulation of the blood in the web of these animals feet was accelerated;† but he found it annihilated when the brain and medulla spinalis were destroyed.‡

By this means our experimenter fully discovered that the movement of the blood in the smaller vessels is under the influence of the nervous system.

G. R. TREVIRANUS,‖ also, in experiments upon frogs, perceived that the circulation of blood was destroyed in the webs of their hind feet, after the section of the sciatic nerves, but which was continued in the anterior feet after these nerves were divided.

There is no doubt, but that these observations which were

some of the small arteries of the hand, affected with forcible and very evident jumping contraction, which, after a few cathartic doses of myrrh, aloes, and asafœtida disappeared. In these cases there were neither disease nor pain in the hand. The well-known throbbing of the arteries in the neck and head, in such cases is also in point, as well as cases of great prostration of nervous influence, and of anemia, when the heart and aorta, have for want of nervous energy, not enjoyed a perfect systole, and struck with a large surface against the parietes of the thorax, so as to simulate aneurism.—*Translator.*

* Philos. Transact. 1814.

† Philos. Transact. 1815, p. 1 and 2.

‡ Meckel, L. C., p. 351. Versuch. 17, 18.

‖ Biologie; 4 ter, Band, p. 646.

made upon the nerves of the extremities are applicable to the branches of the sympathetic nerve.

4th, *The sympathetic nerve forms an admirable chain of connection between the principal organs of the human body.*

It is self-evident, and is proved beyond doubt in the anatomical section of this work, that all the organs which receive branches from the sympathetic nerve are connected with each other. For all the branches are united in the trunks and ganglia that are dispersed far and wide in the viscera of the thorax and abdomen: hence it follows that whatever arises, or is perceived in one organ, is reflected immediately to another or to all the rest. When the stomach is highly excited with aliment, the long tract of the intestines is forced into operation, the liver and spleen grow turgid, the secretion of bile is promoted, the action of the urinary system itself is enhanced, the kidneys determine to themselves the blood and fluids, and the urine is passed off with greater celerity through their apparatus. And vice versa, when one chylopoietic viscus is diseased, the others suffer.

I expressed above, my dissatisfaction with the opinion of Bichat in which the abdominal organs, are treated too *solitarily* (if I may be allowed the expression) and the nervous system of which we speak not sufficiently considered as a whole.

The sympathetic action of our intercostal nerve, is by no means circumscribed to the cavity of the abdomen: on the contrary it spreads itself wider, and connects the separate parts of the body into close union with itself.

Most of the phenomena indeed may be considered as *consensual*, in which the sympathy is proved to arise from the connection and interlacing of the nerves; 1st. Titillation of the nose produces sneezing, because the nasal nerves of the spheno-palatine ganglion, are connected through the medium of the deepseated and superficial vidian nerves, with the sympathetic; from which the diaphragmatic plexus arises, which is joined by anastomosis with the phrenic nerve: 2d. An intense light also excites sneezing, for the impression being perceived by the retina, and transferred instantly to the ciliary nerves, is conveyed to the sympathetic,

and by the nasal branch, and the remaining nasal nerves of the fifth pair: 3d. The anastomosis of this nerve, (sympathetic) with the fifth pair, accounts for the gritting of the teeth, and itching of the nose, in the verminose diseases of children: 4th. Renal calculi or nephritis, produce vomiting, or other disorders of the stomach, whilst the stimulating cause, if confined to the bladder, rarely excites gastric derangement. The cause of this difference is evident. For the nervous communications are more conspicuous and more numerous, between the kidneys and stomach, than between the stomach and urinary bladder: 5th. The observations of celebrated practitioners instruct us, that many labouring under diseases of the abdominal viscera, suffer a cloudiness of vision, that the retina is also drawn into consent,* etc.†

But the medium through which the connection of the nerves is chiefly made, is the par vagum, the principal anastomoses of which with the intercostal nerve, in the neck, thorax, and abdomen, form many plexuses, upon which the action of the sympathetic nerve depends, and through the medium of which, chiefly, that admirable intercourse exists between the head and abdomen, known to physicians in all ages.

In this respect the *fascia communicans of* WRISBERG (§ 89.) is of great importance, and which in my judgment, might be

* Lomnius. Observ. med. lib. 2. Whytt, of the sympathy of the nerves, p. 499.

† This nerve emphatically deserves the name of sympathetic, both from its office of uniting the different parts of the body, and from its anatomical disposition, in which it is connected with the nerves of the head and neck, with the par vagum in the interior of the organs, and with all the spinal nerves, including, as it does in a sort of ellipsis, nearly all the internal organs of the body.

But it is chiefly in diseases that we are made acquainted with the physiological control, which one organ may exercise over the rest, for all the sympathies of disease may be considered in the first stage, but as a magnified view of the customary laws of the organism, many of which in a state of health, are performed so harmoniously as to elude detection. Their knowledge however is of great importance to the practitioner, for it causes his attention to be directed, not so much to the symptoms apparent, as to that condition of the various organs which give rise to them. It gives him often an almost intuitive knowledge of the case, and enables him frequently by simply restoring or retaining the organs in a state of health, to prevent the occurrence, or limit the extension of disease. For the chain of natural sympathies, by which the various multiplied actions of the human system is performed, becomes, when disease assails us through imprudence or inadvertency, the machinery by which a local disorder, when no preventive measures are taken, extends its outposts till most of the organs are subjected to its influence, or the individual is destroyed.—*Translator.*

more aptly named, the *great abdomino-cephalic anastomotic branch*, for by it, the animal life is connected with the nutrient or vegetative, so that the mutations of the one may be immediately felt within the domains of the other, perceived by the mind, and vice versa. I shall alledge some cases of abdominal disease in the third section of this work, in which this sympathy is sufficiently manifest in the morbid state.

5th. I defy the most ingenious physiologist to determine *in mental diseases, the use and functions of the sympathetic nerve.*

No one certainly ever better illustrated the phenomena, which sudden impressions, and passions of the mind, excite in the nerves of the abdomen, than the illustrious BICHAT;* no one has indicated better than him, the nervous centre of organic (vegetative) life. But it appears to me that that celebrated man has erred in admitting the gastric organs, as the focus of organic life, and in ascribing to them actions, which belong more to the semilunar ganglia; that is, to the abdominal brain. I admit however that these organs are intimately connected with the focus of the nerves, which is clearly proved by their anatomical construction. I admit likewise that they may be influenced by the stomach through the abdominal nerves. But I deny that mental affections are felt by the stomach, liver, spleen or intestines, until they run into the abdominal nerves, and affect their centre. BICHAT, supposes that the focus of nutritive life, would be destroyed, if the epigastric organs were separated; if the stomach for instance, were placed in the neck, the liver in the pelvis etc.: this in my opinion is very erroneous, for whatever may be the distance between these viscera, whilst they communicate together by nervous filaments, it is the same as if they were very near or immediately connected together. The cerebrum is remote from the stomach, and its impressions, notwithstanding, are reflected with incredible celerity to the latter organ. They are all sustained by each nervous centre. The latter centre is in the *solar plexus;*

* Bichat, Recherches physiol. sur la vie et la mort. p. 61.

It exists there of right, and if I may so speak, by its own authority. It is immediately affected, no organs being interposed which are in any way connected with it, as the organs of the senses are with the cerebrum. The latter is not excited, except by the intermediate senses: taste, smell, hearing, vision, touch, are all true avenues through which the impressions run in their approach. But in the abdominal brain it is not so: The affections of the mind are reflected upon it without any interposition, without the co-operation of the stomach, liver, spleen, intestines, &c. These viscera may be deficient, and yet the influx from the encephalon to the solar plexus, neither abrogated nor disturbed.

In whatever manner the abdominal nerves are irritated in mental affections, there must always be a sensation in the cerebrum, previous to that irritation. The mind is excited by the aid of the senses; an idea arises in the common sensorium; whether grateful or disagreeable, it is weighed, and the impression then spreads finally into the abdominal nerves, which neither perceive the idea nor are capable of adjudging it. Hence, an idiot, who leads a mere vegetative life, knows nothing of mental suffering. His abdominal nervous system remains tranquil: he is only obnoxious to those mental affections, which belong to the animal appetites, because in his encephalon, which is in other respects uncultivated and imperfect, that portion abounds, from which the par vagum derives its origin; that illustrious point of the cerebrum of the highest quality and importance, where the bond exists, (medulla oblongata) which connects vegetative with animal life. From that portion of the cerebrum, determinations proceed to the abdominal ganglia, in the idiot as in the quadruped: to that place the impressions revert, which arise in the ganglia or are transmitted to them from the viscera, whether these be healthy or affected with disease.

The route by which the descending or ascending impression goes and returns, is none other than the abdominal fascia or the *abdomino-cephalic anastomotic branch.* This alone, and uninterrupted by ganglia, forms the immediate intercourse, between the cerebrum and abdomen. We can trace filaments from the solar plexus, with the scalpel by the naked eye into the right

par vagum, or even into the brain itself. Were this branch divided, the communication with which it is charged, would not be entirely annulled, but would proceed perhaps more slowly and indirectly to the encephalon, by the splanchnic nerve, thoracic ganglia, and medulla spinalis.*

* BICHAT erred greatly both in considering the separate ganglia of the sympathetic, in the light of nervous centres or small brains, and in considering the sympathetic as a wholly distinct system completely independent of the cerebral.

Nor yet should it be considered as an encephalic nerve, arising from the fifth and sixth cerebral nerves, as it was formerly considered; nor as an encephalic and spinal nerve simply, as it is considered by Meckel, differing only from the other spinal nerves, in the multiplicity of its origins, by the plexuses it forms, and the ganglia which it traverses. This view of Meckel's appears too, to be the one adopted by W. Philip. A correcter view of this nerve, and one to which professor Lobstein inclines, is that this and the encephalo-spinal system are primitively separate centres, though of nearly consentaneous origin in the fœtus, and endowed each with separate functions, (that of innervation or organic nervous influence, belonging to the sympathetic nerve) mutually necessary to the support of each other; and that between each system there is a reciprocal interchange of fibres, which when passed beyond the boundaries of their own, are considered as making up a portion of the other system. Thus the learned author of this treatise, asserts that he distinctly observed a difference both in consistence and colour, in the two communicating branches between the sympathetic nerve and the spinal intercostal ganglia. One of these he says was given off and the other received by either system of nerves. By admitting this arrangement, we have at once a satisfactory explanation, for the occurrence of the endless train of sympathies, between the encephalo-spinal system and the sympathetic, in health and disease. It will also explain away the apparent difficulties, in regard to the separate existence of two lives (organic and animal) in the same individual, which has served as a bar to the adoption of the views of BICHAT, the most ingenious and philosophical of any in the annals of medicine.

This view also seems to gain support from the structure of the lower classes of animals, where the two lives as we descend in the scale, become gradually mingled into one, till finally nothing but an organic existence of the lowest grade is met with; in like manner the nervous structure is found gradually degraded; the two systems of nerves, centering by degrees into one, or the par vagum; which has been called the *middle sympathetic*, supplying the place and functions of the proper sympathetic nerve. In the lowest class of animals it has even become a question whether nerves exist.

In human acephalous fœtuses, without brain or spinal marrow which from the entire absence of all the functions of relation or animal life, can be considered little superior to the lower classes of animals, the sympathetic nerve has been found to appearance well developed; proving that notwithstanding the reciprocity between the systems, the sympathetic alone is adequate to the maintenance of that organic, hybernating existence of the fœtus. In analogous cases the nerves of the senses have been found entire in their course from the organs, to the cranial cavity, where they were only fibrous strings. The nerves of the cerebro-spinal system in general existed in these cases.

The great sympathetic is only found as a separate system in vertebrated animals; and in none in such full development as in man.

In the invertebrated the par vagum supplies its place, and is the only visceral nerve and dispenser of organic nervous influence. In man, in consequence of the number of nerves it sends to the heart, lungs, stomach, etc. the par vagum, is considered by some physiologists as holding a sort of middle station between the two nervous systems.— *Translator.*

It follows from what is predicated above, that there exists a sympathetic relation between the cephalic nervous centre and the abdominal which though more evidently diffused, nevertheless converges, in some way into the solar plexus. But frequently this friendly communion is so disturbed, that an antagonism arises between the two centres in the healthy state, but which is much more obvious in the diseased. Nor does this comprise all the phenomena developed here.

Just as the cephalic nervous centre, is capable of being singularly excited and exalted to a wonderful degree of power; so it is with the other, the ganglioso-abdominal centre, which occasionally breaks out from its ordinary sphere, the function of nutrition, and produces extraordinary phenomena in some diseases, of which I shall give a description in the following section.

I cannot pass on without noticing those singular phenomena, which have been lately elicited by the aid of animal magnetism, and which open a new field to physiological experiments.

Whatever may be the opinion hereafter held by judicious men, in regard to magnetic phenomena, it must be admitted that the abdominal nervous centre is forced by the magnetic influence into a new sphere of action; that, in a manner utterly unknown to us, its dignity is elevated to the highest pitch, so as to apparently assume the functions of the cerebrum itself; that extraordinary powers are manifested, of which we had before no conception and which indeed we may wonder at, but cannot explain. From a medical friend, a sagacious observer of nature, without any preconceived opinion on this subject, and who could not have been deceived, I received the history of a young girl, who, during a period of spontaneous somnambulism, which was the effect of disease not artificial, discovered the subject of some letters that were sent to her, and which were placed folded as they came without her knowledge upon the scrobiculus cordis. This fact certainly gives additional weight, to similar observations, which have been long known.

I do not think that these observations which seem to declare the existence of occult powers in human nature should be rejected: and it does not become a medical philosopher in my opinion, to

spurn phenomena without previous investigation, and especially because they are enveloped with obscurity, and do not square with received opinions and vulgar notions. Ampler experiments, if instituted in a candid spirit, would teach us, perhaps, what there is to be found new, or rather to be renovated, in regard to magnetism, and what advantage physiology may derive from it.*

* This alledged phenomenon which has long been considered rather as belonging to the department of legerdemain, than medical science, has been employed too often by the unprincipled, to dupe the credulous, or by religious fanatics to promote the infatuation of their followers. Men have however occasionally come forward in the support of the capability of producing by different means singular phenomena in the epigastric region, who, however liable they may be to error, are like Professor Lobstein, too well known for learning and integrity to allow us to believe that they would hazard such heterodox opinions, wholly without foundation. Whatever truth there is in this obscure subject, it is both interesting and important to the devotee of medical science, that it should be made known, and if it be entirely a fiction, it is quite as necessary that it should be exploded. Electro-magnetism is in itself as displayed in Physics, a subject capable of exciting the greatest curiosity, and of effecting very surprising results. Not the least singular of the circumstances attending it, is the production of an analogous agent in living animals, as in the Electric Fay, (Raja *torpedo*) Electric Eel, (Gymnotus *electricus*,) Silurus *electricus*, Tetrodon *electricus*, and Trichurus *indicus*. From these animals, this peculiar principle is discharged much in the same manner as electricity, and from some of them, in such power, as to have caused the destruction of human life. It is produced by a peculiar organ called the electric, into which a great many nerves are seen to proceed, and from which the singular agent is conveyed by the nerves. SŒMMERING, found the effects of its action was always proportioned to the energy of the vital power and that the interposition of electric nonconductors greatly weakened its action and that the section of the nerves of the organ completely destroyed the faculty. The electric organs are differently situated in the various animals, and present the appearance of numerous strata, cells and prisms, of tendinous partitions, filled with a gelatinous fluid, and, covered in beside the common integuments with a distinct sheath. The number of the cells, of which these organs are internally composed, increase with age, so that HUNTER counted 470 in a small animal, (Electric Ray) and 1180 in a large one. The blood vessels which run to these organs are very few; the nerves are of extraordinary size, as well as in great number. RUDOLPHI, found in this animal three large branches proceeding to their organs, one from the fifth pair, and two from the par vagum, which also formed plexuses surrounding the vessels of the organ. In the Gymnotus, he counted 224 intercostal nerves, which entered the inner side of the organ from one extremity to the other, inosculating with each other, and with branches from the fifth pair and par vagum. He thought he could discover in the organs of these two animals some resemblance to the voltaic pile in one, and to the trough galvanic apparatus in the other.

Considering the number of the nerves and the dependence of this phenomenon upon their activity it is says CARUS at least not improbable that the nervous power accumulates in the cells of these organs, whence it can be voluntarily discharged, in the same manner that it is capable of being collected in muscles, in order to produce their contraction. It is perhaps unnecessary to occupy much space with these observations, but it appears to me important, that this abundant evolution of electric or some analogous power in living animals, should meet from some able hand with further illustration, inasmuch as WILSON PHILIP, has been able to supply, in all respects in many of the organs, the absence of nervous influence with galvanism; and as it would seem right to take a comprehensive view in deciding upon this obscure subject, even when it seems as in the text, to transcend the bounds of all sober probability.—*Trans.*

6th. *The sympathetic nerve, then presides over all the actions, which occur in the recesses of the abdominal organs. It imparts power, tone, strength, energy to these organs; excites, sustains and directs their functions: and on the contrary when it is abnormally affected, disturbs them.*

Physiologists admit a continuous nervous influx into the chylopoietic viscera, and which they consider it perpetual in the functions appropriated to nutrition; whilst on the contrary they acknowledge a continual alternation in the actions which belong to the sphere of the cephalic nervous system.

How this discrimination can be correctly established, I am truly ignorant. For if the external senses, when fatigued, recover their power during sleep, and return to their pristine degree of activity; the same holds with the internal organs which are not under the government of the will. The stomach can not continually and uninterruptedly digest food; it requires repose before it is again called into action. Hunger itself does not depend upon the vacuity of the stomach solely; it is an unpleasant sensation, which most frequently returns at a certain and definite period. As the organs of the senses, are capable of being *educated* and rendered more or less perfect; so the stomach by well directed diet and regimen, is invigorated, and has its digestive powers enhanced.

The *vital* properties of the gastric organs, seem moreover debilitated at certain periods, as they appear different at one period from what they do at another. Thus the great mass of mankind are not able to eat the same articles of food in the evening, which they take without inconvenience at mid-day.

On the other hand, a perfect intermission of the nutritive functions may be observed for a notable period in the different stages of life. The digestive viscera and the kidneys are quiescent in the fœtus; and the organs of generation receive neither increase nor evolution. The spermatic and uterine nerves which are given off from the sympathetic, seem to have acquired no power during the course of many years.

The venereal passion returns periodically in quadrupeds, al-

though the uterus, ovaries, testes, etc, of these animals, receive their branches from the nervous system of the ganglia. If to these it be added, that respiration and the circulation of the blood are suppressed for many months in hybernating animals, it will certainly be admitted that the actions which depend upon the sympathetic nerve, are in some measure periodical.

III. It yet remains for me to attempt to explain the mechanism by which the functions of the sympathetic nerve are performed. But it is not to be expected that I can clearly and completely elucidate a subject which is involved in the greatest obscurity. For the question, in respect to the manner in which the nervous apparatus of the ganglia acts, should belong rather to a comprehensive dissertation upon the action of the whole nervous system, which, it is agreed by all, is one of the most difficult of subjects, and affords nothing but conjectures and hypothesis. The theory of the dependence of the nervous fluid upon the vibrations and oscillations of the nerves, etc. is completely overthrown; nor does there exist any, entirely capable of explaining the action of the nervous system.

It is true, nevertheless, that the nerves are merely conductors of some very mobile, though material principle, which is secreted in their funicles from the arterial blood, during the act of nutrition, or chemico-vital process; not, however, that it emanates from a particular source, like blood from the ventricles of the heart, although in the encephalon, medulla spinalis, and ganglia, it is produced in greater quantity, proportionate to their greater supply of vessels.* The same principle in a kind of halitus or vapour, I suspect, pervades the nervous filaments, and constitutes

* Though as most physiologists admit, the nervous centres constitute the great source of nervous influence, yet as the nervous cords themselves are, proportionably to their size, as well supplied with blood, the material from which it is produced, the latter are said to be also capable of its production, though to such a limited extent, as to make them in general the mere agent of the central masses. For if a nerve is irritated, it will by its own influence at once excite its peculiar functions in the part to which it runs, in cases, where the irritation of the nervous centre, from its disease or injury would no longer produce that result. M. Broussais has even gone so far as to assert that the nerves are every where provided with their peculiar properties which they do not borrow from the brain, and that they only communicate with this centre, in order to form a correspondence between the organs.—*Translator.*

a peculiar imponderable *nervous gas*, which cannot be assimilated to any fluid, either electric or magnetic, but forms a nervous atmosphere about the nerves and muscles, as was proved from experiments by the celebrated HUMBOLDT.* This gas, I believe, is conducted into the intimate structure of the organs, is mixed with the deepest seated of the fluids, and, although the filaments which are placed upon the branches of the vessels, terminate or disappear from the view, yet this vapour, in my own opinion at least, is effused into the cellular texture, penetrates to every point of the organs, and, if I be allowed the expression, fills them with its own atmosphere. This vital nervous halitus or vapour is likewise introduced into the bodies of the vertebræ by nervous filaments, which I have myself, traced into those parts.

The reasons which induce me to admit a peculiar *gas* in the nerves, arise from the multifarious phenomena that occur in the sound and diseased states of the body.

A. 1st. In regard to the former, (the sound state) I think that all vital turgescence may be considered as arising chiefly from a psychological cause. The sudden redness of the face, arising from mental excitement, does not certainly depend upon a general affection of the nervous and sanguineous systems, but upon a topical action of the nerves. The capillary vessels of the skin are here suddenly dilated; the blood is expanded to a volume and extent greater in proportion to the nervous principle mixed with it, and which produces the same effect upon it as caloric in boiling water. The same phenomenon occurs in the turgescence or erection of the genital organs, which is rapidly and often solely by the power of the imagination produced, as it cannot be explained either by spasm, or by the additional arrival of blood from an increased action of the heart. Hence it is manifest why the remarkable nervous branches accompany the deep seated cavernous arteries of the penis; a fact which may readily be observed, not in man only, but likewise in quadrupeds, and especially in the horse.†

* L. C. p. 82, 83, 84, 87; fig. 36, 37.

† Tiedeman, in Meckel's deutschem Archiv. fur die Physiologie, 2 ter Band p. 200.

2d. The gross and brawny states of body, peculiar to certain men, are not always produced by the adipose matter which fills the cellular texture, nor by sanguineous plethora, but by some subtle matter which pervades and distends the parenchyma of the organs. Hence it may happen that these men, speedily, and even in the space of twenty-four hours, assume an emaciated appearance, without the loss of either fluids or adeps. This likewise is the reason why infants and adolescents are more brawny than the old, because in them the impelling power which is produced from the energy of the nervous system is more vigorous.

3d. When experiments are performed upon living animals, we find very frequently that their parts sustain a notable turgescence, and a distinct crepitation is heard under the edge of the scalpel. This phenomenon, which is not found to exist in the cadaver, cannot certainly be derived from the atmospheric air; it depends upon an aerial fluid, which is evolved from the nervous parts disordered by the excruciating suffering.

In the bodies of animals nearly dead from canine madness, the same phenomenon may be observed, the fluids and fleshy parts of which abound with gas before the action of putrefaction commences.*

B. But the chief part of the perceptible phenomena, which appear to manifest the power and importance of the *nervous halitus*, are to be found in the state of disease.

In inflammatory diseases arising from a phlogistic diathesis, the pulse is full and hard; the veins grow turgid; the heat of the body increases: can any one believe that the mass of fluids, and the store of blood is suddenly increased? Certainly not: But the blood, which receives no additional supply from the focus of nutrition, is dilated, expanded, acquires a greater capacity from the nervous principle interposed between its globules, intestinal and livelier motions are excited in it, which are sustained as it were by a latent fire, and which may be compared to the movements that

* Andry. mem. de la Societe royale de medecine ann. 1776. p. 112.

occur in boiling water. All Physiologists know that the blood in inflammatory diseases, is endowed with greater vitality, and is fitter for the preparation of new organic parts (which is manifested by the pseudo-membranes, formed of the fibrous part of the blood, and exhibiting new sanguineous vessels in the space of twenty-nine hours.) And why? Because no doubt, that most important principle which is elaborated by the nerves, and therefore emanates from the highest fount of vitality, is intermingled with it. I have no doubt but that the nerves when excited to increased action, evolve a greater quantity of *nervous gas*; that they are pregnant as it were with this principle, and which they effuse afterwards into the parts over which they preside.

This opinion I think will enable us better to understand why the nervous ramifications constantly run to the arteries, and embrace and accompany them in every direction. It is by no means equally clear, that they transmit the mandates of the will to the arteries, or that they convey the impressions which arise in the network of capillary vessels to the sensorium: but they no doubt serve to impart tone, strength and energy to the parietes of the vessels, and the nervous principle to the blood. The observations of HARVEY, BOHN, GLISSON, ALBINUS, and WILSON,* upon the molecular movement of the blood, confirm my opinion; as well as the experiments of G. R. TREVIRANUS,† in relation to the influence of the nerves in this motion of the blood, and the microscopical observations of ROSA,‡ upon the aerial fluid in which the sanguineous globules swim. I have therefore framed for myself the following theory, not only of inflammation, but also of acute febrile diseases generally.

No pernicious influences can in any other way reach the organism, than by the medium of the nerves. These when subjected to morbid impressions, are so instantaneously affected that they give rise to spasms, which are manifested by shivering.

* An enquiry into the moving power employed in the circulation of the blood. London, 1774.

† Biologie 4 ter. band. p. 646. Vermischte Schriften anatomischen und physiologischen inhalts 1 ster. Band. p. 99.

‡ Lettere Sopra alcune curiosita fisiologiche. Lapoli, 1788.

Hence a chill is the first and a constant symptom of fever. But this affection or derangement of the nerves prepares a reaction, which speedily ensues, and increases, not only the volume, but also the irritating property of the blood. Then the heart and arterial system are excited to quicker actions; the chemico-vital processes become more rapid: a burning heat invades the body; the organic forces are raised to a greater degree of activity; the functions are disturbed; and all the actions of the organism are performed with the greatest impetus. The whole of this state in my opinion depends upon a *nervous plethora*, that is, a nervous gas, collected and accumulated in the nervous filaments, and from thence making an irruption into the parenchyma of the organs, and into the fluids themselves, until it is discharged by the emunctories to the great relief of the sick. When for instance we open a vein in inflammatory diseases, drowsy symptoms are frequently found to occur, and the anomalous actions are suddenly restored to a more natural condition, in consequence chiefly, that with the loss of blood, the principle is withdrawn that forced the vital fluid, as it were into effervescence, and because a twofold detraction is effected by this operation; to wit, of the nervous and sanguineous fluids.

In other cases, the nervous influence extends to the capillary vessels, of the natural excernents: hence it is that the organs for cutaneous transpiration and pulmonary exhalation, are set exuberantly into action by the nervous principle. The mode is here evident, by which diseases may become contagious: namely, the organism elaborates, and through the medium of nervous action, evolves the noxious miasm. This consists of an imponderable matter, analagous to the nervous gas itself, from which it probably emanates. This being admitted, we shall no longer marvel, that any animal miasm immediately affects the nervous system, as by that only it can be perceived, and upon which alone it can make an impression. It was indeed formed from, and has an affinity with the same nervous principle: it has a tendency to return to the place from whence it was produced. I believe therefore that in all contagious fevers, the nervous system

is always the first affected, the perverted action of which is conspicuous over that of the rest, and imparts to the fluid with which it escapes, a depraved imponderable character, which takes place in the following manner in these diseases: 1st. It escapes with, and is thus mingled with the cutaneous and pulmonary exhalations in ataxic or adynamic fevers: 2d. It is united with the blood in malignant fevers, which it expands and sometimes forces into the cellular texture, forming petechiæ and ecchymosis; and sometimes the blood is eliminated by the exhalent vessels, producing hemorrhages which no skill can stop. 3d. It occasionally is retained in the rete mucosum of MALPIGHI, destined for the protection of the nervous papillæ, and elevates the epidermis into chrystalline vesicles called *miliary*, which are more often filled with gaseous than serous fluid.

On the other hand, there are various idiopathic affections of the nerves, of the spasmodic kind, in which this gaseous fluid is evolved in abundance. This class consists of the hypochondriac and hysteric affections, angina pectoris, nervous apoplexy, etc.

I receive it as fixed, that in the paroxysms of these diseases, the nervous pulp is saturated with the peculiar principle it bears, the mode of action of which is such, that when it is rapidly added to the secreted humours, it escapes from the body as the patient recovers, or with his destruction if the nervous fluid is mingled with the blood. Every one knows that the paroxysms of hypochondriasis and hysteria, angina pectoris, etc. are dissolved by a copious eructation of flatus, whilst in the species of apoplexy referred to, aerial bubbles have been found enclosed in the vessels of the brain.* Hence it is unusual to meet with a neuralgic affection of the nervous system, and especially of the sympathetic or pneumogastric† nerves, in which there is not an extrication of aerial fluid or true *pneumatosis*.

* *Morgagni*, Epist. anat. 3, No. 17; Epist. 59, No. 18. *Fabricius*, acta naturæ curiosorum, vol. x. p. 117. *F. Zuliana*, de apoplex. præsert. nervea. comment. § 26. *Portal, obs. sur la nat. et le traite de l'apopl. p.* 288.

† The exact limits of the office which the par vagum performs in the human system has not yet been satisfactorily decided. It sends branches to many organs so entirely different in their functions, as the muscles of the larynx, lungs,

Now to return to my subject, I consider there is residing in the nervous filaments, a subtle, imponderable, cogent matter, analagous to the magnetic or electro-galvanic fluid, and which is secreted and transmitted by the nervous pulp, constituting the sole active principle that resides in the nerves. I admit that this very mobile substance, which possesses the highest degree of importance, forms a nervous atmosphere about the trunks and branches of the nerves as well as the muscular structure, as was first announced by the sagacious genius of REIL, prior to the experiments of HUMBOLDT* and ALDINI,† which were made with the greatest care, and completely established its existence, and also that it was endowed with the property of sensibility; that is, with the faculty of perceiving a stimulus, and by the aid of the organs from which it emanated, of reacting against it. I consider that this nervous atmosphere, which an ingenious physiologist has denominated *organic ether*,‡ by sweeping through the organs, draws them under the dominion of the nerves; and I assert upon anatomical grounds, that it is effused into the humours of the body, and even into the blood itself, to which it gives a character of vitality. To the action of this organic ether, I attri-

heart, and stomach, that it is difficult to believe they are endowed with no other properties than those of the other encephalo-spinal nerves, that of communicating, sensation and motion; neither of which in their more ordinary development, can be said to exist in the heart and stomach. It is likewise difficult to believe in opposition to many of the most distinguished physiologists, that it is a dispenser of the organic nervous influence, an office which by BICHAT, GALL, REIL, and BROUSSAIS, is said to belong solely to the great sympathetic nervous system. M. BRACHET has asserted (an opinion in which he seems to be borne out by the result of many experiments by different persons) that the par vagum in these organs, merely presides over the sensations which are located in the interior organs, such as the want of respiration, hunger, thirst, etc., as the nerves of the lower part of the spinal marrow, over the organs of urination, and defecation; the sympathetic maintaining the organic actions of the parts. M. GALL asserts, that many of the nerves usually considered as sent from the par vagum to these organs, belong properly to the sympathetic. The intimate connection between these nerves in the neck and thorax, has already been described, and their direct communication in the epigastrium so emphatically depicted by M. LOBSTEIN, seems in further corroboration of these opinions. It seems, therefore, that we are obliged to admit, either that part of the structure of the par vagum, is composed of filaments from the sympathetic, or that that nerve holds a middle station in function between the two grand divisions of the nervous system.—*Translator.*

* Place last cited.

† *Essais theoriques et practique sur le galvanisme; tom.* 1, *p.* 13, 15, 86.

‡ *Eschenmayer*, Professor at Tubingen.

bute the phenomena perceived in the healthy and diseased states, the chief of which I have already indicated.

This terminates what I have to say in regard to the mode or mechanism, in which the sympathetic nerve displays its peculiar properties, and performs its functions.

If any one is disposed to deny the existence of the nervous ether, because a ligature placed upon the nerves induces a paralysis in the parts below where it is tied, let him consider, that this operation effects an alteration in the nervous pulp, and excites a commotion in the nervous funicle, by which its power is lost. Here the same phenomenon takes place in the nerves, as we see occur in experiments in physics, in regard to the motion of the magnetic fluid. A simple blow, applied in a particular way upon the iron conductor, annihilates at once the magnetic influence which it had before possessed.

SECTION THIRD. PATHOLOGICAL.

§ 111. Having described the healthy condition of the sympathetic nerve, it is but a natural transition to proceed to the study of its diseases. For in the morbid affections of the body, the vital energy is generally deranged, and the organic structure likewise more or less impaired: hence, as is proved by numerous examples, physiology is closely allied to pathology, or rather, these two branches of medical science are closely linked together.

§ 112. It was long suspected by physicians, that the ganglionic system of nerves was affected, in the nervous diseases of the abdomen, and that especially in hypochondriasis and hysteria the nerves of the abdomen were subjected to some alteration. This suspicion is now confirmed, and it is established as a pathological dogma, that these diseases are to be referred to a pure and simple neuralgia of the abdominal nerves.

This certainly is not the place, to furnish a graphic description of the diseases which are produced by the affection of the system of abdominal nerves; it will be well, however, to advert to their leading symptoms, in order better to illustrate the perverted action of the nerves.

§ 113. I will commence with *hypochondriasis* which is gradually established under a continued and hidden depression of mind, with sadness and the corroding effects of silent grief, until it finally bursts out in *spasmodic* symptoms, with deceptive vehemence.

All the symptoms of this disease, certainly demonstrate that it is of a *spasmodic* character, and evince a morbid condition of the ganglionic system of nerves. The remarkable sensation of pressure in the præcordia, after taking food; the difficult digestion of food accompanied by a development of flatus, anxiety without any disorder of respiration, palpitations of the heart, vertigo, tremors of the joints &c., are phenomena which can only have their seat in the diseased nerves of the abdominal viscera. The

vital actions of the gastric organs, which give rise to no disagreeable sensation, and of which we have even no perception in the state of health, now make an unusual impression on the brain, from which the mind necessarily forms a mistaken opinion in relation to the vital processes going on in the abdomen.

Hence it is, that impressions transmitted to the brain by the nervous ramifications from the interior of the abdomen, excite sudden alarm, the fear of apoplexy or other serious diseases, when the individual is not exposed to the least danger.

The derangements of the abdominal nervous system, and its irruption into the cerebral sphere, sometimes produce such changes in the constitution of the mind, that the chain of reflections become so much impaired from the multitude of phantasies which arise, as to give rise to symptomatic loss of mind and genuine delirium, which disappear as the mind regains its energy.

The mind is very frequently forced into various emotions, bursting out on every slight occasion into scornful laughter, and as quickly from a like simple cause, again relapsing into sadness and tears.

§ 114. *Hysteria*, which I believe to be an utterly different disease from hypochondriasis, consists in an affection of the uterine nervous system, with which the nerves of the epigastric organs, and especially the lungs are drawn into consent, so that dyspnea and constant constriction of the tracheæ, form a part of the morbid symptoms. This affection is extended likewise, with much activity into the dominion of the brain; when the exaggerated power of the sympathetic nerve, begets strange mental aberrations, and produces actions that appear to be spontaneous, but which in fact are perfectly involuntary.

Spasms of a lighter kind are frequently felt to commence in the abdominal region, and to spread by degrees upwards through the chest, where they produce a sensation of vibration, and oscillation in the integuments and muscles of the head and face; and to excite intolerable pains, which occupy by turns the sinciput and occiput, in some instances a half only and in other cases the whole of the head; sometimes they are limited to a small space, which

may be covered with the ball of the thumb, attended with an incessant sensation of cold, and yield to no remedies but those that remove the derangement in the abdomen, and obtund the excessive sensibility of the viscera. Hence those which were before the most excruciating, are found to be mitigated immediately by a single eructation of flatus, and to have the pains quickly relieved by a few drops of laudanum or a few grains of castor.

In the clinical institute of this city, we watched the case of a a young girl during many months with great attention, in whom we could daily trace with admiration, the course which this disease (hysteria,) pursued in the various branches of the nervous system. At first there was only spasms in the inferior part of the abdomen; then pain and distention of the epigastrium, with a sensation of anxiety and inclination to vomit; afterwards constriction of the lungs, dry cough, palpitation of the heart, followed by attempts at deglutition, as if pellets of food which the patient wished to swallow had stuck in the pharynx, and finally, perfect aphonia. More than twenty times, this train of symptoms assailed the patient in such a manner as to develop every day a new phenomenon; and as often the disease appeared to us to have migrated into another plexus of the nerves. For it originated in the hypogastric plexus, from whence it proceeded into the gastric and solar plexuses, from thence into the pulmonary and cardiac plexuses, from these into the nerves of the pharynx, and ultimately into the laryngeal and recurrent nerves.

The morbid symptoms subsequently disappeared gradually from above downwards to the pelvic organs, in a mode, the reverse of that in which they arose, to be quickly again repeated as before.*

* Within a few years past the infallible existence of either acute or chronic inflammation, in nearly all derangements of the system, has become more problematic, and the attention of physicians, has been much turned towards the part which the nerves play in the production of diseases. The respective publications of Messrs. Teale, and Tate, with which the public has lately been favoured, have produced much good, by exemplifying in the strongest manner, the visceral disorders which may be maintained by focal irritation or inflammation in the different masses of the nervous system, and especially in the spinal marrow; these disorders had previously been considered under a variety of appellations, and when remedies were applied, they were directed frequently

§ 115. The seat of *melancholy* and many forms of *mania*, in the general opinion of physicians, exists originally in the deep-seated viscera of the abdomen. What was formerly ascribed to obstructions of the viscera, and principally of the spleen, and to

to the apparent seat of the evil in the extremities of the nerves, and not to the real cause which existed in the centres from which these nerves proceeded. The ganglia of the sympathetic nerve, when diseased, not only in this way produce derangement in the parts to which their nerves are sent, but likewise give evidence of their own disorder, by causing irritation and tenderness upon pressure over the spinal marrow, between which and the ganglia nerves of communication run. In this way the medulla spinalis serves as a sort of index to the visceral disease, and which it may also complicate with other symptoms, (such as deranged action of the heart and lungs,) through the medium of the branches which this portion of the nervous system gives off to the pulmonary and cardiac plexuses. In addition to the effect of pain, there is also very excellent testimony in favour of the belief however difficult it may be to account for, that all severe lesions of the nervous structure are apt finally to excite inflammatory action in the parts to which the nerves are distributed. In the experiments of DUPUY, referred to in § 100, of this work, it is shown that the excision of the superior cervical ganglia of the sympathetic nerve in the horse, was productive of emaciation, œdema, general cutaneous inflamation, and finally of death. Intense inflammation, with ulceration and sloughing, has frequently taken place in the eye ball, and in some cases in the membrane of the nose and in the gums, as was first ascertained by MAGENDIE, both from an artificial section, and from disease of the fifth pair of nerves which supplies these parts. Inflammation with an increase of secretion in the mucous membrane of the bladder have been known to follow injuries of the spine, in many cases of paraplegia. Admitting the importance and usefulness of the views, particularly inculcated by the writers above mentioned, it would seem that the tenor of their doctrines were inclined to give so undue a prepondency to the affection of the spinal marrow, as to throw into obscurity, the primitive disorder of the abdominal viscera, the common cause of all the catenated nervous symptoms. It does no doubt often occur, that after the internal affection has subsided, the secondary affection of the spinal marrow still exists, and maintains a train of symptoms which may be relieved as if by magic, by the effect of local bleeding and revulsives at the spine. But in the far greater number of cases, it is most important to keep in view during the treatment and remove the original source of the evil, while we combat at the same time its sympathetic effects on other parts. It is less likely that the spinal marrow should be primitively affected by disease encased as it is in its canal, without the application of direct violence, than the abdominal viscera; which are exposed in a thousand ways to every species of derangement, from the ingestion of improper articles into the alimentary canal, or in disorders of their functions of external relation such as urination, menstruation &c. In the chronic diseases of some of these organs, as the uterus for instance which receives few or no nerves of sensation, what way exists, through which the intellectual organs may be apprised of the circumstance, but by the sympathetic extension of the disorder, through the ganglia and plexuses of the abdomen, and from thence to the brain by the par vagum, or through the spinal nerves which mingle in the hypogastric plexus, to the spinal marrow. In either instance, it is equally important, that the view of the practitioner should extend through the train of effects, up to the first cause of the disease in the viscera. The amount of influence which the spinal marrow really exercises over the visceral nerves, has not only been thus exaggerated by practitioners, but by several experimenters in physiology. The puncturing, burning, and crushing of the spinal marrow, so frequently resorted to, for direct evidence of its control over the functions of the pectoral and abdominal organs, has given it in this

infarctions of the vessels, is referred at this day with more reason to an altered condition of the nerves. *Vapors* do not ascend into the head, nor does *atra bilis* form a part in the production of these diseases; but the solar plexus, or abdominal brain, reacts in such a manner upon the cephalic brain as to produce a manifest change in the character of the mind. The existence of this wonderful connexion, or rather antagonism of the brain with the abdominal nervous system, is explained in the physiological section of this treatise, where the subject was discussed. The clearest demonstration of this fact is found in the cure of the above mentioned diseases, by medicaments which irritate and derange the nerves of the abdomen.

The wonderful power of emeties when productive of nausea only, the beneficial use of which is proved by experience in diseases of the mind, substantiates this fact. This class of medicines never act in these cases as the solvents or evacuants of the sordes and saburral matter; but as efficacious irritants to the gastric nerves, through which the effect is subsequently extended to the solar plexus, and thus changes the mode of action in its nerves; or at least through the intimate connection of the plexus with the brain, the disorder of the latter is counteracted and drawn to the abdomen.

§ 116. The seat of *saturnine colic* is without doubt, to be found in the abdominal nerves. What other system exists, to the affection of which could be attributed the excruciating pain of the intestines, the retraction of the abdomen towards the spine, the alvine constriction, tenesmus, suppression of urine,

respect an undue physiological importance; all the results which occurred, (partly from the sympathetic action of the injury upon the brain, and the mutual derangement excited between that organ and the sympathetic nerve,) having been attributed to the direct effects of the operation through the branches which the medulla sends to the ganglionic system. All the visceral organs in the fœtal state, as was expressed in a former part of this treatise, were endowed with the visceral nerve prior to the existence of the brain and spinal marrow, and consequently can only relatively depend upon the latter in the maintenance of their functions, so far as they form a part of the *circulus* of Hippocrates; the sympathetic nerve maintaining the actions of the nutritive vessels of the brain and spinal marrow, and the latter furnishing part of the power with which the sympathetic nerve performs its functions; while both systems coincide in the support of the intermediate function of respiration, the sympathetic moving the venous blood into the lungs, where it is arterialised through the influence of the cerebro-spinal.—*Translator.*

palpitations of the heart, asthmatic paroxysms, inclination to vomit, cardialgia, vertigo, cold sweat, palsy, etc., which characterise this disease, but the ganglionic system of nerves, and the muscular fibres of the intestines under its control? There is certainly no symptom observable in this disease, which cannot be explained by the affection of the nerves.

§ 117. The various spasmodic paroxysms with which patients are differently tortured, should likewise be considered as arising from irritation of the nerves. Thus, although *tussis ferina*, or *convulsiva*, (hooping cough) is chiefly located in the pulmonary apparatus, it seems, notwithstanding, to extend its pernicious influence in the cæliac plexuses: for whence comes the titillation at the scrobiculus cordis, which patients experience in this disease, until the occurrence of the violent and suffocative convulsion which ensues?

Why do children run about with such anxiety previous to the eruption of a paroxysm? Why does vomiting so frequently take place? How does it happen that clonic convulsions, which endanger existence, almost always accompany or succeed the cough? Can it after these observations be denied, that some dynamic or vital influence of the par vagum and epigastric plexuses invades the cerebral sphere, and effects a change in its condition?

§ 118. The præcordial spasm, known under the name of *angina pectoris, inconstant arthritic asthma, sterno-cardia* or *syncopes anginosæ*, seems to me to consist essentially in an affection of the cardiac, and perhaps also of the pulmonary nerves. It attacks the organs of the chest: a constriction of the thorax takes place producing excessive pains, runs transversely outwards, terminates in the arms, and afflicts the patient with an inexpressible sense of anxiety. These paroxysms, which are suddenly excited by excessive bodily exertion, by the excessive indulgence in food and alcoholic drinks, and especially by depressing mental emotions, are dissipated by an eructation of flatus. Here we find a confirmation of the theory which I laid down above,* that neuralgias constantly produce pneumatosis. But the

* See page 109.

occasional causes of this disease, as well as the sudden occurrence of its paroxysms, most clearly evince a dynamic affection of the nerves. I know very well that in the bodies of those who have died with this disease, osseous incrustations are often discovered at the origin of the aorta and pulmonary arteries, in the semilunar valves, in the callous ring which separates the cavities of the ventricles and auricles, and frequently in the tunics of the coronary artery. But in my opinion, these phenomena are the effects only, and in no wise the causes of this disease, since they have been found in many individuals who did not die under any form of angina pectoris, and were never subjected to its attacks.

When, however, such ossifications are met with in this disease, we may clearly comprehend their mode of production, if we recall to mind the jurisdiction which the nerves exercise over the vessels to which belong the functions of nutrition: for the nervous filaments act upon the capillary vessels, the functions of which they elevate, when the latter, thus forced into an unusual manner of action, gives origin to a peculiar substance, in the texture of the above named portions of the heart. It is well known by every cultivator of pathological anatomy, that the fibrous texture of whicl the arteries are composed, is very easily penetrated by the phosphate of lime.

As to the remote cause of angina pectoris, I do not imagine that it is always to be found in the arthritic diathesis; and I know not why we should refuse to believe in the existence of any other pernicious powers, capable of producing injury in the cardiac nerves. The celebrated WINCHMAN* moreover asserts, that there were no perceptible symptoms of arthritis in the cases of angina pectoris which he had noticed.†

* Ideen zur Diagnostic; 2 te. Auflage, 2 ter Band, p. 163.

† It has long been the habit of the Professor of the Practice of Medicine in the University of Pennsylvania, to impress upon his class the intimate connection, if not identity between angina pectoris and some forms of gout. He also describes cases occurring in his own professional sphere, where the subjects of the latter were affected with the former disease, and in whom life was terminated with much the same awful rapidity, as takes place in those affections called gout of the heart and stomach. It may be asked with much advantage to the enquirer, what is gout?—A question once thought not difficult to answer, when the ontological notions of medicine were received as infallible dogmas. At the present time, it has become the prevailing system not to study with devotional zeal, the doctrines of the schools, or trust to the defective lights of mere exter-

§ 119. We adjoin to the aforesaid disease another kind of asthma, called *incubus* or *ephialtis*, which attacks individuals only in the night. For the sensation of a load at the præcordia, with short laborious sighing, and suffocative respiration, when individuals go to sleep upon their back with their head depending; suspension of voice and speech; hallucinations of the mind and senses, to which females chiefly are obnoxious; brief, but often reiterated attacks; palpitation of the heart, with terror and profuse sweats; great lassitude after the paroxysm is over, and the occurrence of yellowish spots, which are sometimes seen scattered over the body, etc., all constitute phenomena indicating the existence of a dynamic affection of the solar plexus, which transmits the most injurious impressions through the par vagum to the brain, produces disagreeable sensations in the joints by means of its anastomosis with nearly all the rest of the nerves, and finally governs the capillary vessels through its nervous ramifications, or perhaps excites some intestinal action in the blood itself. Perhaps there is in this affection some development of the electro-

nal experience, but to learn from the unerring school of nature, the functional and diseased actions of each organ of the human frame; to learn the part first invaded by the disease, and the mode and the direction in which, by the natural route of the sympathies of the body it involves the rest. This method needs no other recommendation than that of its very general adoption. Hence it cannot be of any disadvantage to ask, whether gout does not simply consist in some derangement of the functions of the alimentary canal, in which the central masses of the nerves of organic life are greatly irritated, and perhaps in the more inveterate cases inflamed, which may be temporarily relieved by metastasis to the extremities, by the same sympathy that causes that weakness felt in the limbs, from accumulation of bile, or constipation;—or whether this disorder of the nerves, may not, in other cases, extend up the sympathetic nerve and par vagum to the heart and lungs, and produce cases of derangement, or arrest of the functions of these organs, identical with angina pectoris. It is certainly much more important to know the nature, than the names of disease; and its entire limits than its separate phases.

I have in several instances, seen females about the middle period of life, who had from puberty been continually subject to paroxysms of sick headache, from which relief was generally sought by vomiting, and sometimes by catharsis, followed by subsequent doses of opium. As these sufferers advanced in life, the paroxysms were much less frequent, and in one case diminished entirely; but when the functional derangement of the chylopoietic viscera, which formerly had produced headache took place, the sympathetic irradiation upwards, through the sympathetic and par vagum nerves, produced such excessive functional distress in the heart and lungs, as to necessitate a resort to the usual medicines for relief, before the head was affected. Here there were great palpitation of the heart, and embarrassment of the circulation, and most suffocative asthmatic respiration, with pain along the spine, (on pressure) and sometimes in the arm and shoulder,—in short, a case analogous to angina pectoris.—*Tr.*

galvanic influence, which, when artificially applied, produces succussions in the nerves and muscles, with which all physiologists and physicians are well acquainted.

§ 120. Whenever in different diseases nervous phenomena are discovered in the region of the epigastrium and præcordia, there is some disorder always to be found in the branches of the sympathetic nerve.

Idiopathic miliary disease is always preceded by symptoms of the gravest character; to wit, oppression of the chest, shortness of breath, stricture of the præcordia, and especially a sensation of anxiety; a series of symptoms which seem to threaten the wretched sufferer with instantaneous death. There is no system certainly, but that of the nerves of the abdomen to which we can possibly attribute this array of afflictions. For no one will admit that the causes of these phenomena exist either in the diaphragm, liver, stomach, spleen, blood-vessels, cellular texture, or membranes, but all must agree that they are only to be found in the great organ of sensation, which reacts upon and controls the other viscera, and which though overwhelmed as it were for a time by the violence of disease, subsequently recovers itself, and gives rise to a variety of anomalous paroxysms, until it (nervous system) is freed from the destructive miasm, by the production of a cutaneous eruption.*

* The term *idiopathic miliary disease* is here meant to embrace the severe train of internal diseases which are sometimes succeeded by the millet seed form of eruption. All the various eruptive phlegmasiæ, as scarlatina, small pox, etc. commence their career only as functional or organic lesions of the interior organs of the body, for which they must be treated, and for more than which they cannot be known, until they have developed their peculiar effects upon the surface of the body. *Idiopathic miliary fever*, or *miliary disease*, is precisely analogous in its operation, where the term is used to signify the abdominal disease, which is sometimes of the severest character, that has preceded the eruption of minute vesicles, called miliary, upon the skin. But unlike the proper exanthemata, this eruption does not possess a peculiar appanage of visceral derangements which invariably precede it. It sometimes supervenes upon trivial occasions, when the functions of the skin only have been impaired, by that organ being retained for some time in an unusual degree of excitement, by a burthen of clothes, or the protracted action of diaphoretics, aggravated by a retention of its excrementitious discharges: therefore, though the peculiarity of this disease (the eruption) can only be considered as an incidental phenomenon, supervening occasionally upon the severest abdominal disorders, it by no means diminishes the vast importance of the part which the sympathetic system of nerves plays in the latter affections, and of the great attention which it is necessary to pay, when the principal functions of life are embarrassed by an impaired condition of the sympathetic system of nerves.—*Translator.*

§ 121. *Latent Arthritis*, of an inferior grade of intensity, or which is not yet fairly developed, often lies concealed under the form of *spasmodic* affections of the hypochondria; and it appears to merit our particular attention, that the genuine hypochondriac affections when long protracted, are finally removed by an attack of gout; whilst on the other hand, arthritis itself is capable of producing the miliary disease: hence it becomes evident, that there is some affinity between the merely nervous diseases of the abdomen and arthritis and miliary fever.

§ 122. In reflecting upon the nature of *intermittent fevers*, I have thought that it might perhaps be found in the disorder and perverted action of the abdominal nervous system, and there appear indeed to be sufficient grounds to render this opinion probable; 1st. The cases of this disease are very rare, in which the functions of the abdominal organs continue vigorous, and entirely unaffected: 2d. The commencement of the paroxysms is often marked with vomiting: 3d. We experience daily, that this disease is mitigated, and very often entirely removed by the use of cathartics: 4th. A single emetic, when given previously, sometimes suppresses the paroxysm, and not unusually removes the whole disease; from which it appears that this remedy makes an impression upon the solar plexus, of an opposite nature to that which had produced the fever. 5th. When the disease is either left to itself or maltreated, congestions are produced in the abdominal viscera, induration of the liver, intumescence of the spleen, etc., and the general morbid state is changed into a topical affection. This metaptosis appears to me to prove that the morbid action, prevails at first in all the plexuses, and afterwards migrates from one to another. For it is first apparently disseminated in the whole territory of the ganglionic system, before it runs with much impetus into a single plexus, which is commonly the splenic; and as the vessels are under the influence of the nerves, it cannot be otherwise than that congestions should thus be produced in the vessels: 6th. The paroxysms of intermittent fever, are tied down to a regular rythmus, in consequence of their being radicated in the nervous system upon

which nature has impressed a law, according to which they must perform their functions periodically. (p. 97, No. 6, and 98.)

§ 123. Each nervous system therefore is obnoxious to its own diseases. But the mode in which the cerebral and spinal nerves, and the nerves of the abdominal plexuses and ganglia are affected by disease, is the same. As in the various kinds of convulsions, epilepsy, tetanus, etc., there is disorder in the voluntary nerves, even when no organic lesion can be discovered in them; so the nerves of the thoracic and abdominal viscera, may be affected without any alteration perceptible to the senses. As the perverted action of the cephalic brain, is reflected with great force upon the abdominal brain, so in turn does the latter react upon, and overwhelm the former; and finally as the cerebral system when it is stupified as it were by the violence of disease destroys life, in like manner I believe, an analogous effect takes place in certain diseases in the solar plexus. It has been long taught, that sudden deaths take place in the human body, in three different ways, by the cerebrum, heart and lungs; and I would add to this a fourth, the solar plexus, the source and centre of the abdominal nerves, which when subjected to a sudden concussion or any serious derangement whatever, is affected with a paralysis, which is speedily followed by death. There are many instances in which injuries inflicted externally upon the epigastrium, have produced death by their mechanical effects. 1st. The dropping of water from any height upon the scrobiculous cordis, cannot be long borne. 2d. A boy was killed from being struck by a playmate on the epigastrium with a snow-ball, which left no visible marks on the organs within.* 3d. RUYSCH, who during fifty years, taught anatomy at Amsterdam, states that sudden death may occur from a concussion of the mesenteric nerves (solar plexus) without the existence of any lesion in them which can be detected. 4th. An electrical discharge through the abdomen, may cause instantaneous death. This is confirmed† by

* Metzger, system der gerichtlichen Arzney-wissenschaft; 3te, Ausgabe. Kœnigsberg, 1805. § 142, not. 2.

† Observat. sur l'anguille electrique, Recueil d'observations de zoologie et d'anatomie compar. tom. 1. p. 56.

HUMBOLDT, who saw himself, the electrical eels, (Gymnotus Electricus,) when placed under the bellies of horses and mules, destroy the lives of these animals, by the sudden emission of their electric fluid. 5th. In the recession of the miliary exanthemata, by which patients are suddenly destroyed with a development of the severest symptoms, inexpressible anxiety, suffocative asthma, &c., whilst the function of the brain is unimpaired, there is proof that an impression is thrown upon the solar plexus and the par vagum which are closely connected together, and produces the partial death of those nerves, called with much justice *abdominal paralysis or apoplexy.*

§ 124. Let us now turn to the sympathetic diseases, the source and seat of which exist in the abdomen.

The symptoms are innumerable which are openly manifested between the head and the viscera of the abdomen, however great may be the harmony existing between these organs: for a thousand observations teach us, that there is no affection of these viscera, either dynamic or organic, which does not sometimes sympathetically affect the head.

§ 125. Hypochondria and hysteria, of which I have just treated, very often excite *hemicrania:* this affection frequently passes off in vehement pains, and spasms of the occiput, extending to the neck and scapulæ, or the eye of the affected side becomes swoln and sparkling, is depressed within, or projected beyond the orbit, and suffers greatly by exposure to light; the pupils are contracted, the tears flow in streams, the palpebræ become of a shining redness, and serum is discharged in considerable quantity from the nostrils. It is easily understood how these symptoms are produced in the various diseases of the abdomen: for we find, as is displayed in the anatomical section of this treatise, that there is a very intimate communication of the sympathetic nerves, with the fifth pair, par vagum and cervical nerves. The intercostal nerve therefore, or the par vagum, being affected in the abdomen, the irritation accruing from this cause, readily rises into the nerves of the head, where it excites pains and *spasms*, which take place the more readily, as there gene-

rally occurs at the same time, in consequence of the abdominal spasms, a greater congestion of blood in the vessels of the head.

§ 126. We learn from daily experience that sympathetic cephalalgia, arises very frequently from obstruction of the bowels. F. HOFFMAN, VAN SWIETEN, and a host of others, have cured the severest cases of this affection, by cathartics. In whatever manner, the affections of the head are produced, it is certain that the abnormal state of the intestines, is reflected by the nerves to the brain, although by the application of an irritant to the intestines, viz. purging, it may again be attracted downwards.

§ 127. The congestion and induration of the chylopoietic viscera, effect such a change in the sensibility and tone of the abdominal nerves, as to give rise to injurious sensations, and in consequence of this, disagreeable impressions are carried to the head, the effects of which are manifested either by headache or vertigo. It is likewise deserving of remark, that affections thus produced, sometimes attack the head upon the side of the diseased viscera, so that from a lesion of the liver, beside the cephalalgia of the right side, there is especially, a tinnitus of the right ear; and occasionally the same phenomenon is observed in the disease of the spleen: this may now be very readily explained, since JACOBSON has detected the anastomosis in the tympanum (§ 48.)

§ 128. Every one is aware, that intestinal worms, occasionally produce a variety of diseases. There are many examples of the occurrence of spasmodic affections from this cause, especially, headache, spasms of the neck and torpor of the principal senses, which after venesection, scarification, etc. had been practised in vain, were cured by mercurial cathartics. What physician is ignorant of the fact, that verminose fever is often attended with the severest symptoms, so as to induce an incurable form of dropsy in the ventricles of the brain?

§ 129. There are many cases of *sympathetic soporose disease* bordering on apoplexy and belonging to the same class of affections which seem to ascend from the interior of the abdomen to the brain, and that may be removed by the evacuating plan with

such invariable and complete success, that scarcely one good physician can be found, to object to the use of cathartics.

The same thing occurs in sympathetic delirium, the origin of which is so frequently found in the præcordia, that every day's experience confirms the saying of Tissot,* "that in twenty cases of either acute or chronic delirium, eighteen arise from the hypochrondria." That all these affections of the brain, depend solely upon the morbid condition of the abdominal nerves is manifest from this fact; that in the same class of diseases when arising from known causes, as for instance, poisonous ingesta in the stomach, no organic disorder can be detected in the cavity of the cranium.

I admit however that a cure may be produced by the same mode in idiopathic diseases of the brain, when we act upon the intestinal canal, and excite revulsion towards the abdomen. But this fact itself and the success of its application, furnishes another argument in behalf of the intimate connection, that is believed to exist between the head and the nervous system of the abdomen.

§ 130. No one will doubt the propriety of enumerating *sympathetic agrypnia* among the affections of the abdominal nerves, who considers with me the numerous causes of irritation proceeding from the abdomen, that augment nervous action, determine the movement of the blood towards the head, and obstruct the supervention of the principal causes of sleep.

Hence we find that those who have gorged themselves at supper, are wakeful after the first period of sleep has passed, and are scarcely able to fall into repose again. We hear very often, when there are no strong sensations, or severe symptoms to excite suspicion of incipient cerebral disease, that patients labouring under acute fevers, have passed many sleepless nights, or that when sleep did supervene, it was interrupted or disturbed with frightful dreams. If we open the bowels in these cases, which before were constipated, if we loosen and evacuate

* Dissert. de feb. bilios. opusc. t. 1. p. 77.

the humours collected in the primæ viæ, which are corrupted by their detention, and irritate the nerves; if we excite the languid and almost suppressed vital movement of the intestinal canal, by the aid of purgatives; we find that sleep of a more natural kind, will be speedily regained by the patient.

§ 131. I have often observed a species of *insomnia*, which I believe arose from an irritation of the nervous system of the abdomen. It occurred in cases of the miliary disease; for after this affection had been chiefly subdued and the remaining symptoms were fast disappearing, an inveterate state of vigilance nevertheless existed for many weeks, which exhausted the patient's strength. I convinced myself, that this symptom was owing neither to the existence of fever nor to the congestion of blood in the head; but that it arose from a disagreeable sensation, diffused over the whole abdomen, and from obscure and irregular movements perceptible within that cavity.

I have noticed in general, that there exist diseases, and certain states of life in which the ganglionic system, when it has become unusually excited, and, if I be allowed the expression, morbidly vigilant, overwhelms and oppresses the cerebral system, acts upon the encephalon like the external senses, and prevents it, although fatigued, from obtaining repose. I have seen some unfortunate patients who, though they had but just fallen asleep, would be suddenly awakened, in dismay, by a powerful and apparently electrical shock, from the epigastrium; an afflicting phenomenon, to which they were subjected for many months.

§ 132. The sympathetic affections of the eyes and nostrils, depending upon causes within the abdomen, were known to physicians from the earliest ages.

The physicians of VRATISLAW,* describe a severe epidemic opthalmia, complicated with vehement headache, and a liability to blindness, arising from some disorder in the hypochondria, in which nothing proved of greater utility, than free catharsis of the bowels, occurring either spontaneously, or

* Hist. morb. Vratislaw. Laus. et. Genev. 1746, p. 237.

provoked by medicines. We are told by FOTHERGILL,* that he cured chronic opthalmia by the aid of tonic medicines, which restored the power of the stomach and intestines.

Corrupt matter, adhering to the intestines, and infesting their nerves, is very often the only cause of dilatation of the pupil, amblyopia, nyctalopia, hemeralopia, and amaurosis. The most frequent complaint of hypochondriacs, also, is that the eyelids oscillate and tremble, as at the approach of sleep, attended with some sensation of roughness and weight; and that they feel a pressure over the supercilia and forehead like the constriction of a band. As to the shedding of tears, the livid circles surrounding the palpebræ, the inflation of the lower eyelid, every one knows, that they indicate some nervous affection of the abdominal viscera; hence they are habitual to those who are afflicted with worms or chlorosis, or during the period of menstruation.

In regard to the sympathetic affections of the nares, the false perception of odours, and the troublesome pruritus with which the verminose are vexed, the hemorrhagies from the obstructed viscera of the hypochrondia, etc. all furnish very evident proofs that the action of the abdominal nerves is of a perverted character and is directed towards the head.

§ 133. If I am not greatly mistaken, I have observed a peculiar sympathy between the teeth and a disordered state of the abdominal nerves. I have found that the cause of *obstinate tooth-ache* oftener exists in disorder of the chylopoietic viscera than in any defect, depending upon the crasis or constitution of the fluids. Women who are especially liable to hypochondriacal attacks, have their teeth frequently in a state of caries, atrophy, or necrosis, although they may make use of the best articles of provision, and exhibit no symptoms of depraved digestion. The hysteric passion, on the contrary, I am convinced produces this phenomenon much more rarely; which is of so constant occurrence in the preceding case, at least in our section of country, that one would be justified in immediately conjec-

* Of the use of the Cort. peruv. in scroph. disord. Med. observ. and inquir. vol. I. p. 303.

turing the existence of abdominal irritation from the diseases of the teeth.

§ 134. The action of the abdominal nervous apparatus is not limited to a few fixed parts alone, but extends in such a manner likewise into the other nervous system, (which is formed of the encephalon and medulla spinalis,) that it is capable of altering completely, and very frequently of depressing the tone and energies of the latter. Hence arise lassitude of the joints, hebetude of the external senses, and the purely *sympathetic astheniæ*.— There exists sometimes, as VAN SWIETEN* thought, in diseases in the region of the præcordia, something that prostrates as with a poisonous blast, all the energies of the system in a moment, and whilst it continues to act, is productive of the greatest debility; although there is no wasting of the fluids, nor any observable change in the solids or liquids. Hence arose the surprise expressed by SYDENHAM,† that in continued epidemic fevers, there should be, beside other symptoms, such as anxiety, jactitation, and laborious respiration, great and sudden prostration of the forces, all of which were susceptible of being removed by the exhibition of a single emetic. Thus, as the result of his experience, BALLONIUS‡ has also most judiciously observed, that even in the most depraved condition of the fluids, there was not so much depression of the bodily and mental energies, and that the physician need not fear the production of debility in such cases by the use of evacuants; a precept which the authors above have strenuously enforced, and the correctness of which has been proved a thousand times over by its successful application. I admit, however, that these observers have ascribed the diseases arising from the abdomen, to corrupted, pituitous, bilious, saburral humours, etc.; but whatever may be the opinion we entertain in regard to the true existence of these humours, it is nevertheless positively determined, that the abdominal sensitive system, when either primarily or secondarily affected, may trans-

* Comment. in Boerh. Aphor. t. 2. p. 271, 272.
† Oper. t. i. p. 32.
‡ Oper. t. I. p. 1. 153. 157; t. IV. p. 130.

pose the affections of the abdomen from place to place in the organism: whence it is that those who are not in the least tinctured with humoral pathology, are compelled to fly to nervous action for the explanation of the phenomena of disease.

§ 135. But the physiological condition of the system itself, as well as experiments upon healthy individuals, fully prove the influence of the nutritive nervous, over the animal nervous sphere. For how powerful is the sympathy, we daily observe between the strength of the joints and senses, and the viscera of digestion? A certain geometrician, who, before dinner was able to solve the most difficult problem, became totally stupid after eating very largely of a repast. Hence with the greatest propriety BOERHAAVE* says, "When I see the writings and listen to the conversations of the wise, who consider that the nature of their thoughts depends solely upon themselves, I am astonished that food alone can be capable of overwhelming that particle of divine flame, the human mind."

Let a healthy individual, take a good sized dose of opium, or of any other poisonous medicine, as for instance, hydrocyanic acid; he will speedily feel intoxication, heaviness of the head, languor of the joints, inertia, will stagger, etc., though the medicine may have not yet passed beyond the limits of the stomach.

§ 136. When this antagonism which exists between the abdominal nervous system and the cerebral, is well understood, we shall no longer be astonished at the sudden diseases which carry off the sick, by paralysis or apoplexy of the *brain*. For whatever may be said in relation to those cases of apoplexy, of which the cause exists in the abdominal organs, should be attributed originally to the irritation, derangement, and disease of the nerves of the interior of the abdomen. In intermittent apoplectic fevers, therefore, (pernicious intermittents of ALIBERT) the morbid cause is generally found to exist in the abdomen. We find no mention made of any remarkable disorder of the cerebrum, as being the idiopathic cause of this disease.†

* Prælect. academ. vol. iv. p. 488.
† Werlhoff, obs. de feb., p. 21. Medicus. Beobacht. 1. p. 379.

It is proved from experience in a similar manner, that the essential cause of arthritis, (§ 121) may be either retained in the nerves of the viscera, and not obtruded upon the joints, or, when incautiously thrown back from the joints upon the nerves, produce cerebral apoplexy, which may be properly considered of the *spasmodic* species, since by the concurrent testimony of anatomists, it is very frequently impossible to discover any material cause of this affection after death, either in the encephalon or nerves.

There are many other examples of sudden death, arising from affections of the mind; to wit, from joy, fright, fear, rage, which appear to assail the nervous centre of the abdomen, and to destroy the individual by producing a *paralysis* or *apoplexy of the latter*, (§ 123) and not by the *paralysis*, or *apoplexy of the brain.*

§ 137. In all the diseases to which we have hitherto alluded, the affection of the abdominal nervous system, is only of a dynamic character, consisting solely in a derangement of its forces, and vital properties; its vitality is either exalted or diminished, or varies from its usual condition, without any organic change capable of being detected in it by the senses. But this disorder, morbid tone, or *ataxia** of the nerves, exercises, by degrees, more and more influence over the organs, brings them into its own morbid sphere of action, if I may be allowed the expression, and finally generates diseases, in which genuine alteration of structure is visible. Examples will furnish a better illustration of this subject.

§ 138. Grief, melancholy, and all mental afflictions which depress the vital power, and are for that reason called *sedative*, produce a change in the tone of action of the abdominal nerves. Spasms are then produced, which disturb the action of the vessels, from which necessarily follows a stasis of the fluids in the capillaries, from the retarded motion of the blood; and lastly, infarc-

* Those diseases are said to be ἀταξίας, which attack in a vague, irregular, disorderly manner. A. Fœsii œconomia Hippocratis. Hence the term ataxia has passed through the ancient, as well as most recent medical writings.

tion of the vessels, obstruction of the viscera, and genuine organic diseases. Protracted mental depression arising from the sufferings produced by disease at the præcordia, have been known to give rise to aneurisms of the heart, and very frequently of the larger vessels. Many unfortunate individuals who have been pursued by adversity, and loaded with an insuperable crowd of afflictions, have in the course of time become affected with indurations of the epigastric viscera, particularly of the pylorus, and finally of the pancreas, liver, and spleen. In a love sick girl, who had sunk under the blighting of her matrimonial prospects, I discovered a peculiar organic disease of the ovaries; which it is my intention to describe in another place.

All the changes of these organs depended primarily upon the altered state of the nerves, and were undoubtedly *dynamic* diseases before they degenerated into *organic.*

§ 139. I have been fully convinced by the most attentive observation of disease, that spasmodic (spasticus) symptoms always for a considerable time, precede organic alteration.

1st. In affections of the head, every one knows that convulsive movements of the facial muscles, gritting of the teeth, strabismus, etc., indicate a serious lesion of the brain.

These symptoms should, I think, be enumerated merely as the *prodromi* of dropsy of the ventricles, because they are sometimes treated with the happiest success; which, in my opinion, can scarcely ever occur, if a collection of water has already taken place in those cavities. The perverted action of the brain, is by no means circumscribed to the cavity of the cranium; it is extended to distant regions of the body, whence organic diseases are produced. After lesions of the brain, there is undoubtedly a dynamic disorder of the nervous apparatus of the liver, antecedent to the inflammation and suppuration of that organ. Various hypotheses have been invented to explain the connection between the brain and hepatic system, none of which have yet been at all satisfactory. I may with better reason refer it to a communication of nerves, and chiefly to the communion of the right par vagum with the solar plexus, by which the cerebrum is connected to

the right semilunar ganglion, from whence emanate directly the posterior hepatic nerves.

2nd. Aneurisms of the heart exhibit preparatory symptoms depending upon irritation of the nerves, especially when they originate from gouty affections, and are slowly formed.

The heart is often, for a long time, subjected to palpitation and tremors, or nervous oscillations, before it is affected with the genuine form of dilatation.

3rd. The morbid affections are very diversified which precede the alteration of the lungs. The patient is often, for many years, obnoxious to spasmodic attacks, to which at length supervene ossifications of the trunks of the arteries where they emerge from the heart, as occurs, for instance, in many cases of angina pectoris. I have likewise seen some forms of phthisis, that in their incipient stage, presented no symptoms but those of abdominal neuralgia; viz. paroxysms of hypochondriasis, dyspepsia and swelling of the hypochondria. The lungs, in these individuals, seemed a long time absolutely unaffected; so that, from all appearances, it might have been said, that the general and nervous affection was suddenly changed into an organic lesion. I saw a young girl, who finally fell a victim to pulmonary phthisis, in whom the disease had begun with a pain in the knees, which was followed from metastasis, with gastric oppression, and anorexia.

I have attended patients, during many months, who laboured under a slow fever, and in whom there appeared to be no symptoms of disease of the lungs, until their organic lesion was suddenly developed.

4th. In abdominal diseases, the nerves are sympathetically affected before they produce organic lesions in the viscera to which they run. I am acquainted with many instances of induration of the pylorus, which have arisen after a long continuance of *hypochondriasis*. The symptoms of a more or less severe character, which constitute in the first place, a lesion of the stomach, intestines, liver, spleen, etc. are, in general, nothing but dynamic spasms (insultus) of the nerves, and which clearly

demonstrate, that there is in these cases some peculiarly preternatural degree or violence of action, (if the expression be allowed,) by the intervention of which the organic disease is produced. Of all the other symptoms, however, the extrication of flatus, or *pneumatosis*, is the most conspicuous, (p. 109,) which arises from the perverted action of the nerves. There is no disease of the abdomen, the lesions of the peritoneum not excepted, but in which there is observed a troublesome and frequent evolution of gas. This is always ascribed, and erroneously, to dyspepsia, to the retrocession of miliary eruption, to hysteria, etc.; but the evolution of flatus is most generally symptomatic of some disorder of the nervous system, and of the incubation of some future organic disease. The strange sensations of the sick, which it is vain to attempt to describe in words, such as inquietude, wandering pains, sighs and groans which they unconsciously utter when asleep, all attest the existence of the same affection of the nerves. In nearly all diseases, both dynamic and organic, jactitation, anxiety, tension of the præcordia, dread of death, etc., in the sick, give me the greatest alarm; because these phenomena (when they do not depend upon hypochondriasis or hysteria) indicate the most serious affection of the sympathetic nerve.

§ 140. Although it has been said, that there is nothing in the affections of the sympathetic nerve to be detected by the senses, yet I am convinced, by attentive autopsic researches, that phlegmasiæ positively do occur in that nerve, corresponding to various diseases. Hence I am fully convinced, that other organic changes might be found in the intercostal nerve, if the cultivators of anatomy would sedulously investigate the subject. I will narrate, in the mean time, what I have myself verified by the most careful observation.

§ 141. A female of excellent habits, who had suffered from the age of puberty with spasmodic and hypochondriacal symptoms, and had twice been attacked with incomplete apoplexy which left an imperfect paralysis of the right side of her face,

was married, after she had passed her forty-second year, and become pregnant fifteen months afterwards. She was subjected, after the eighth week of gestation, to a series of afflictions, under the excruciating torments of which she ultimately died; to wit, spells of vomiting, the commonest symptom of pregnancy, which occurred more than thirty times a day, and produced such distress, that for three months every thing that was taken into the stomach was immediately rejected: and although every measure was tried likely to arrest vomiting both internally and externally, during the last seven days of her existence, not even a single drop of the water she swallowed was retained in the stomach.

From these repeated attacks of vomiting, the fauces and interior of the mouth, became first inflamed and subsequently mortified, emitting a most fetid odour; the fingers themselves, which the patient sometimes put into her mouth, were ulcerated from the effects of the putrid sanious discharges. But the most distressing symptom of all, was a burning pain in the course of the vertebral column, and in the lower portion of the right hypochondrium, which produced several twists in the body and exhausted the strength of the patient by incessant jactitation, day and night. The only way in which this pain could be alleviated for any length of time was, by dry friction; at first with the hand, and afterwards with the towel; which at last were so frequently repeated, as to excoriate the whole surface. Her wretched existence was finally terminated under the worst form of marasmus. I carefully examined the body of this female forty-eight hours after death. The cranium appeared to me unusually small, although the individual was not at all deficient in intellect. I removed the cranium, but could detect nothing præternatural in the cerebrum, which, however, I most studiously examined, because this woman had been tortured during nearly the whole period of her life, with paroxysms of occipital headache, the severe pain of which could only be removed by continued pressure with the hands upon the head, assisted by large doses of opium.

I was likewise unable to detect in the encephalon any organic cause of the chronic delirium to which she had been subject, and which for a very long period had disordered her sleep.

The neck showed a scrofulous enlargement of the glands, a complaint very usual with us, but which in no way had caused injury by pressing upon the blood-vessels.

The thoracic viscera were perfectly sound.

The stomach, which the discharges of black vomit that had occurred in the disease had induced me to believe gangrenous, exhibited no organic affection: neither in the intestines nor urinary organs could any change of structure be detected. The liver was the only abdominal viscus that appeared diseased; it was of a livid colour. In the uterus, which was then in the fifth month of pregnancy, there was no appearance of disease, except a few fibrous tumours in its substance of the size of walnuts.

The neck of the uterus was hard, and perfectly closed at its external orifice, which had prevented me from succeeding in the efforts I had to make to produce abortion, in order to get rid of the continual vomiting in this way, by removing the cause. The fœtus was healthy and in its natural situation.

Having removed all the viscera, I sought out the semilunar ganglia, which I likewise separated from the body, and most carefully examined in our anatomical amphitheatre. These bodies were not, indeed, found converted into any foreign substance, but were of an intensely red colour, which, by some experienced men and distinguished anatomists, to whom I commnnicated the case, was admitted to be the product of true and genuine inflammation. This inflammation was so obstinate, that the ganglia, after three days maceration in cold water, were but little altered in colour: I then had a drawing made of the right ganglion, of which a representation will be found in Plate IV. of this treatise. Its superior part was of a lively red; but the inferior from which the mesenteric branches are sent off, was of a livid colour. The splanchnic nerve just before its entry into the ganglion, appeared to me much broader than usual.

I am strongly led to believe that this singular inflammation of

the ganglia, which I then only, distinctly and satisfactorily observed for the first time, formed, in the case of this female, a chronic affection, which had been gradually increasing in intensity during a long period of time. Should not the numerous nervous and hypochondriacal affections, the excruciating, but merely symptomatic headaches, and the delirium she early experienced in her sleep, all which were so conspicuous in this case, be attributed to this morbid alteration? All these symptoms which had existed nearly the whole period of her life, (from the age of puberty) were undoubtedly raised to the highest degree of severity, by the unhappy circumstance of her pregnancy, by which the nervous disease of the abdomen was increased, and finally gave rise to the emesis, which proved fatal. I am at least, myself, convinced that the burning pain at the vertebral column (except the cause of the disease, should possibly have been concealed in the medulla spinalis, which I was not allowed to examine) depended upon the inflammation of the ganglia.

§ 142. This observation has induced me to be very attentive to the condition and character of the semilunar ganglia and solar plexus in diseases in which I suspected an affection of the abdominal nerves, and where spasmodic symptoms had existed either in the viscera of the thorax or epigastrium.

I dissected the body of a girl, six years of age, who had been seized with epidemic pertussis, which was first converted by metastasis into a spasmodic vomiting of three days continuance, and finally degenerated into an incurable form of clonic convulsions, from which she died.

I found the whole left part of the solar plexus in this case inflamed, whilst the right appeared to be in a natural condition.* In order that I might more satisfactorily ascertain whether in this place there existed genuine inflammation, which possibly might have been only accidentally red, I immersed the plexus for a few days in pure water. At the end of this period, although the red-

* See plate V., fig. 1.

ness of the inflammation was removed, there still existed a yellowness in the part affected, not discoverable in the other healthy portion; this proves that some alteration had taken place in the former.*

I sought in vain for the causes of these convulsions, in the encephalon of this subject, since they were, no doubt, entirely symptomatic, and produced by the morbid reaction of the solar plexus upon the brain.

AUTENRIETH† the celebrated professor at *Tubingen*, on examining lately, the body of a girl who had died from pertussis, found the par vagum inflamed in the whole of its course through the thorax. The neurilema of this nerve was elegantly displayed in consequence of the vessels being filled with blood, and the nervous pulp was also of an imperfect red colour. The cardiac nerves, and the thoracic portion of the sympathetic nerve had likewise suffered some alteration.

The same author asserts that he has seen the abdominal nerves themselves a little changed, in subjects who had died from typhus fever. This observation I am not able to confirm by any experience of my own.

§ 143. I have received the detailed history of two cases of disease, which plainly denotes the existence of inflammation in the semilunar ganglia.‡

The first occurred in a man forty seven years of age, in whom a fibro-cartilaginous tumor, which was loosely attached to the dorsal spine, had been removed by the knife. Two years afterwards he returned to the Hospital for relief, requesting that another tumor, which had been developed upon the site of the former, and over which the skin was highly inflamed and ulcerated, might also be cut out. He had been previously affected with a diarrhea, and exposed at the same time to the cold, in the rainy

* See plate V., fig. 2.

† Tubinger Blœtter fur Naturwissenchaft und Arzneykunde; erster Band, 1815.

‡ These observations were communicated to me by Dr. ARONSSOHN, a very able Surgeon of the Strasburg Hospital.

month of October; he was immediately seized upon entrance, with trismus and opisthotonos, in consequence of which he died in about three days, in despite of all the medical aid we could afford him. In the examination of the body, there was nothing unusual discovered, except, 1st. a vascular network well filled with blood, upon the surface of the spinal marrow, and a quantity of effused serum within the sac formed by the dura mater; and 2d. a very distinct inflammation of the semilunar ganglia.

The other history was that of the disease of a woman, thirty-six years old, who in her second pregnancy, was subjected to vomiting throughout the whole period of gestation. It continued after parturition had taken place, but was rendered at least milder, by the appearance of a furfuraceous eruption upon the breast and arms.

To these morbid symptoms were afterwards added inflammation and swelling of the left knee, and diarrhea; but after the supervention of the latter, the vomiting which had been so obstinate and continual for almost three years, was brought to a close. Finally, hectic fever was developed, which by exhausting the strength, gradually terminated the existence of this suffering female. On examination after death, the villous coat of the stomach appeared to be inflamed, and thicker than usual, especially towards the pylorus, and the semilunar ganglia were found in a state of genuine inflammation.

In the body of a boy ten years of age, who had died from the retrocession of a miliary eruption, attended with symptoms of great anxiety, oppression of the chest, and distention of the epigastrium, I found a place in the left trunk of the intercostal nerve, highly inflamed between the eighth and tenth ribs, with a phlogosis of the ninth and tenth thoracic ganglia, and their two anastomotic branches from the costal nerves.*

These marks of disease in the sympathetic nerve, should not assuredly be despised, nor the inflammation be lightly thought of in which the vital forces are undoubtedly raised to the highest

* See plate VI. fig. 11. let. *e*.

grade of intensity, and produce phenomena of a more or less serious character.

§ 144. On examining into the condition of the nerves in diseases of the lungs, I discovered another alteration which is peculiar to these organs; to wit, in that species of peripneumony, in which the lungs become red and slightly indurated, and which from its similarity in appearance to the spleen, should I think be called *splenification or red broncho-puriform congestion;* the nervous filaments attending the ramifications of the bronchia were found equally red, a little more tumid, but much more tender than usual; so as to be broken by the slightest degree of force.

This however is the only state of the lungs in which I have been able to discover any organic change in the branches of the nerves: they presented nothing unusual in the ulcers or vomicæ, in the hepatiform induration, or in any of the tubercles of the lungs. I examined the lungs of a female filled with numberless tubercles, of which the largest was the size of an orange, and the smallest that of a cherry stone: The whole weighed nine pounds after the heart had been separated. All the tubercles were formed of a matter resembling the fœtal brain, not enclosed in cysts, but in contact with the parenchyma which was perfectly healthy. The whole of the superior lobe of the right lung, was converted into a vast sac, filled with this pultaceous substance, with which a mass of coagulated blood was mixed. The pulmonary nerves, when examined with the greatest care, were not found to differ in the least from their healthy condition. They ran into, and perforated the tubercles; but without undergoing there any alteration, or as was believed, leaving in them any of their filaments.

§ 145. I have very frequently seen the nervous branches composing the anterior and posterior pulmonary plexuses, compressed, displaced and forced apart by lymphatic glands, that were so congested as to form a tubercular mass—but still more frequently by calcareous tubercles which were firmly attached to the bronchia. When these glands, abounded with black fluid, I have seen the incumbent nerves died with the same colour; they like-

wise appeared to me in these cases more tender than usual, as they were very easily ruptured.

But in regard to the stony concretions, I have many times found them so closely attached to the nerves, that they could only be separated from them by considerable force. Besides in the lungs, I have found the nerves in a similar condition in the solar plexus, at the margin nearest the capsula renalis. I have likewise found a small concretion of the size of a cherry stone in the trunk of the par vagum, separating its filaments from each other, whilst the functions of the lung and stomach were in these cases unimpaired.

§ 146. The observations I have made in reference to the cardiac nerves, have principally been in cases of aneurism of the aorta: for these nervous cords rarely suffer any organic change in diseases of the heart.

I have discovered in cases where the arch of the aorta was very much dilated, that the nerves were apparently received into grooves in the thickened tunics of the artery, whilst in their ordinary state, they appear like reddish bands simply agglutinated to the vessel. They seemed to me also, more elongated and redder than usual in these cases; in every instance the patient had complained of a burning pain in the breast, which I could ascribe to no other cause than the inflammation and deranged condition of the nerves; for there was nothing unusual to be found in the other organs or in the nerves contained in the cavity of the thorax.

§ 147. An unmarried female, sixty-four years old, who was subject to a great many morbid affections, remained under my care during a long period of time. She had formerly suffered from gout in the hand, which left behind it some deformity of the metacarpal bones: She was again attacked in 1819, with arthritis, to which was added a miliary eruption, covering the whole of the left arm. Symptoms analogous to hydrothorax, speedily made their appearance, but which was removed by venesection—a measure strongly indicated in consequence of the imminent danger of suffocation.

Her health then became considerably improved, and continued

so during several years; emaciation and debility subsequently occurred, and finally, another attack of asthma was developed which harassed the patient by day and night. For many months she was unable to breathe, save in the erect posture, had a small and very irregular pulse, a pallid face, speech checked through fear of suffocation, œdema of the feet, obscure and pulsatile movements in the upper part of the left side of the thorax, and pain in the humerus of the same side, all which indicated the existence of organic disease in the lungs and præcordia, which was considered at one time to consist in hydrothorax, at another in congestion of the lungs, and subsequently in a disease of the heart or larger vessels. The use of antispasmodics aggravated all these symptoms. Venesection alone afforded relief, which was however but of a few hours duration. This woman finally died in the clinical institute of this city, with all her mental functions unimpaired.

Upon opening the body, a large quantity of serum was found in the right cavity of the thorax; the lung of the same side had suffered the *broncho-puriform* induration, the left lung was shrunken, there was also dropsy of the pericardium, and the cavities of the heart were dilated so as to form what is called passive aneurism: the parietes of the anterior ventricle, were extremely thin, scarcely two lines thick. The pulmonary artery which was very much dilated, was an inch and nine lines in diameter: its orifice was an inch broad. The diameter of the aorta at its orifice was very little above seven lines; but immediately after its origin, it was dilated into a vast sac, two inches and seven lines in diameter. The adscititious tunic of this artery formed of the reflected pericardium, was thickened, whitish and changed to a cartilaginous consistence; between the other tunics there existed numerous osseous scales; but there were no ossifications or stony incrustations discovered in the semilunar valves of either the aortic or pulmonary arteries, in the fleshy rings which separate the ventricles from the auricles, nor even in the valves of the ventricles. But the principal disease we met with in these places, was an aneurism arising from the concavity of the arch

of the aorta, three inches and three lines broad, and two inches and eight lines in height, furnished with dense parietes which were formed of pseudo-membranes, placed one upon another. The aneurismal sac, was intimately connected with the pulmonary artery by very short and dense cellular texture: and the par vagum and phrenic nerves, which rested exteriorally upon it, were enclosed between the pseudo-membranes of its walls. But which more particularly merits attention, there were no nervous branches to be found between the aorta and pulmonary artery, proceeding as is usually the case towards the heart for the formation of the coronary plexuses. But the aneurismal sac itself, was filled with polypous blood, denser and more lamellated at the exterior than within.

This autopsis furnishes a satisfactory explanation of the phenomena which were perceptible during the life of the patient. Orthopnea was certainly to be expected to have occurred in the latter period of the disease from the hydrothorax and hydrops pericardii.

The congestion of the right lung in its inferior portion, and the shrivelled condition of the left, served to render the orthopnea more severe. The aneurism of the aorta produced the obscure pulsatile motion in the left cavity of the breast, and perhaps the pain in the left humerus. But is it not probable that the diseased condition of the nerves bore a part in the production of these phenomena? Would not the compression of the phrenic nerve and par vagum by the dense false membranes of the aneurismal sac, prevent the nervous influx into the organs, to which those nerves belong? Was not also the shrivelled state of the left lung produced to all appearance by the constriction of the par vagum? And is it likely that the absence of the principal cardiac nerves was of no importance, or that this did not constitute one of the causes of derangement in the action of the heart?

§ 148. In a case of aneurism of the heart, where an *active* dilatation of the left, and a *passive* dilatation of the right ventricle, were produced by bony concretions, I observed at the commencement of the arch of the aorta, and in the callous ring of the

aortic ventricle, an osseous scale, an inch in length, with spinous processes projecting toward the base of the heart, and situated in the sulcus which separates the right ventricle from the auricle. In dissecting out the anterior coronary plexus, I found its branches completely surrounded this scale, and by which I have no doubt, they were much irritated in extraordinary movements of the heart.

§ 149. In the heart of a female thirty-one years old, who had died from hectic fever after congestion of the lungs, I found the principal cardiac nerve of the right side, tumid, reddish, and gangliform, near the base of the heart, for a space of eighteen lines, and two and a half broad, exhibiting a blackish point in the middle; this enlargement differed from the true ganglion in this respect, that it was softer, and when pressed with the finger appeared to be hollow; which, however, was not found to be the case on dissection of the nerve.

§ 150. The inflammation peculiar to the nerves of which we treated (§ 140—143) differs from that, which seems only to be communicated to them by the phlogosis of neighbouring parts: for in this case the redness of the nerves is less intense, and disappears by macerating them in water.

In a very violent case of pleurisy which I dissected, the first thoracic ganglion was neither increased in size, or density; but upon its surface there was a red vascular network, elegantly developed. The redness did not in this case extend into the central structure of the ganglion, which when cut in two, appeared of the same colour as the other ganglia that were perfectly healthy. The same fact, with little variation, was noticed in the nerves of the intestines.

Part of the jejunum, contained in a hernial sac where it was incarcerated, exhibited the deepest inflammation in all its tunics, as well as in the mesentery. I eagerly embraced this opportunity to examine into the nature of the nerves, and determine whether they were in such cases, in a state of inflammation or not. I found the intestinal nerves more red and pulpy than usual, and even somewhat pellucid: whilst on the contrary, their

trunks near the place of incarceration, were of their usual character and colour. Will it then not be correct to infer from this autopsis, that the medulla of the nerves may be locally nourished, increased and modified without the other portion of the nerves being affected by the alteration?

§ 151. The branches of the sympathetic nerves have appeared to have been enlarged in various diseases. A. DUNCAN* has noticed a case of diabetes, in which the urinary bladder was very much dilated, and the sympathetic nerve three or four times larger than usual, from its ingress into the abdomen to its termination in the pelvis.

I have myself observed the nerves forming the suprarenal plexus, much thicker in disease, where the capsulæ renales (renes succenturiati) which were more than twice as large as usual, had degenerated into tuberculous substance.

There were eight branches sent off from the right semilunar ganglion, to the suprarenal capsule of the right side, and thirteen from the left semilunar ganglion, to the capsule of the left side. All these branches were terminated at the surface of the capsules. I detected this organic disease in an unmarried woman of twenty-five, who had been affected with chronic miliary disease. The eruption, from the effect of a fright she experienced, had been repelled from the surface, after which there arose convulsive spasms, analogous to the epileptic, under which she finally sunk. Nothing unusual was discovered in the body of this woman, but the aforesaid change in the suprarenal glands, and the enlargement of the nerves.

§ 152. It has been proved by observations undertaken for that purpose, that the nerves may not only be increased in thickness, but likewise in number.

1st. I dissected a case of hydrosarcocele, in the spermatic cord of which I detected many nervous filaments, though evidently belonging to the sanguineous vessels, of which one ex-

* Reports of the practice of the clinical wards of the royal infirmary of Edinburgh, during the months of November and December 1807, and January, May, June and July 1818.—Edinb. 1818.

tended to the vas deferens. I convinced myself in each case, with the microscope, that I had not mistaken the lymphatic vessels for nervous filaments.

2nd. A peculiar organic disease, in which the epididymus alone was changed into a cyst, containing a serous liquor, and which, for this reason, might properly be called *epididymico-cystid*, presented to me in a similar way, a body of nervous branchlets, passing to the testicle itself.

3rd. In a thyroid gland of remarkable size, weighing four pounds, which had been converted into innumerable cysts, abounding with limpid, gelatinous humour, I discovered a great many nerves. Three nervous trunks which proceeded from the laryngeal nerve, and upper cervical ganglion, entered the gland on each side, in company with the superior thyroid arteries.—Each arterial branch had an attendant nervous filament, not connected immediately to the tunics of the vessels, but adhering to them by the aid of cellular membrane. But all these nervous branches which were linked together by anastomotic filaments, formed a beautiful plexus; they were united with the nerves of the opposite side, and thus formed a kind of crown around the superior part of the gland.

From this crown branchlets descended upon the external face of the gland, one of which was joined by anastomosis with an ascending filament from the recurrent branch of the par vagum.

Nevertheless, all these thyroideal nerves, which formed a network about the arteries at the upper margin of the gland that excited my admiration, presented nothing unusual in their structure or appearance.

§ 153. But the contrary of this phenomenon is observed in other instances; to wit, where the number of nerves is greatly diminished.

I found a kidney entirely destroyed by suppuration with the exception of a coriaceo-lardaceous capsule, which still existed and was full of pus. The pelvis was distended with matter, as well as the ureter, the parietes of which were very thick and hard. There were also observed some indurated and apparently

scirrhous adeps, upon the surface of the same kidney, which is frequently found in other organic diseases, and especially in those produced by chronic inflammation. The renal plexus was composed of only five branches, (§ 36) which were little connected together, but exhibited a ganglion half a line broad. When the kidney with its nerves were dried, an oily fluid was exuded from the nervous branches; but the nerves of the other kidney, which was healthy, when dried in a similar way, did not exhibit this phenomenon.

§ 154. In reflecting upon this difference of the nerves, it appears to me that we ought to acknowledge two peculiar states of the parts affected by organic diseases.

Thus in one case, the organs may be converted into another kind of structure, but not corrupted in character; on the contrary the parts that constitute it may be more fully developed. The arteries, for instance, may be more numerous, the veins more dilated, the cellular texture contain a greater abundance of fluid, the cryptæ and follicles increased in size, and the lymphatic vessels more conspicuous, etc. There is some peculiar physiological modification undoubtedly corresponding with this change of structure; the vital forces are perhaps increased or altered in their natural properties and direction. Thus, the unusual secretion of gelatinous fluid which I described in the thyroid gland, and the extraordinary condition of the vaginal tunic, which was the source of serous fluid in the diseased testicle, imply an augmentation of the organic forces.

What is there then to surprise us, in discovering as we do in these cases a greater interlacing and abundance of nervous structure than is usually met with?

But in the other or opposite condition, this state of things does not exist. The organs have likewise undergone a change; but it is that of wasting, corruption, and evident destruction. Their natural structure has disappeared; but although another condition has been substituted in its place, there is no development of new vital forces, new uses, or new functions. There cannot be, therefore, in these cases, the least necessity for a fuller de-

velopment of the nervous apparatus,—it appears on the contrary, diminished in amount, and of less importance.

§ 155. I am very well acquainted with the fact that the nerves resist for a long period, the causes which finally effect their destruction. CHAMBON DE MONTAUX* noticed a gangrenous ulcer which, though it had destroyed the cheek and parotid gland, left the pes anserinus entirely uninjured. I have myself observed lumbar abscesses, in the foci of which, the nerves forming the lumbar plexus remained unimpaired, although they were constantly steeped in a sanious fluid. But in cold, steatomatous, encysted tumours, etc., I have found the nerves apparently shrunken, dryer and flatter than usual, and applied upon, or agglutinated to the tumours; and in abscesses upon the dorsal spine, produced by caries of the vertebræ, I have seen the nerves entirely destroyed.

A girl of ten years of age, who had been affected with paralysis of the lower extremities for a very considerable period, laboured for three months under diarrhea, with incurable tormina and tenesmus.

On dissecting the body, I found nothing unusual in the tract of the intestines; but there existed a remarkable abscess on the left side, which extended from the sixth to the tenth dorsal vertebra. The larger splanchnic nerve which was unchanged in its structure, was in contact with it. The semilunar ganglia were in a healthy state, and there was no apparent derangement in any of the nervous branches proceeding from the solar plexus.

When the abscess was opened, I discovered a caries by which the bodies of the sixth and seventh dorsal vertebræ had been destroyed, though the intervertebral cartilages, and investments of the spinal marrow were uninjured. The left trunk of the sympathetic nerve, was entirely destroyed from the sixth to the twelfth vertebra; the lumbar portion of the same nerve was in a state of inflammation. The medulla spinalis, corresponding to

* Voightel, Handbuch der pathol. Anat.; 1ster Band, § 663.

the carious place, was found for the space of sixteen lines whiter than usual, and in a state of atrophy.

§ 156. Glandular tumours are sometimes developed in the cavities of the body, (particularly in those affected with a scrofulous taint) in which the nervous filaments are compressed or displaced, though very rarely altered in their structure, with the exception of the development of adipocire, which is formed and deposited *during life* between the nervous filaments.

§ 157. I have in some other instances found small tubercles seated upon the semilunar ganglia, to which they were connected by short cellular texture. They were of a peculiar character; of softer consistence than the conglobate glands, and of a yellow violaceous colour. I was not able even with the microscope to detect any lymphatic vessels proceeding from them. *These* tubercles were discovered in the solar plexus of an individual, who had died of colica pictonum. I cannot say whether or not their presence had produced any derangement in this case, or been connected with the above disease; but their existence certainly proves that some abnormal action had existed in the nerves, and in which it had caused the deposit of some unusual matter by a vice of nutrition.

I discovered tubercles of the same kind likewise in an individual, who had died from scirrhus of the stomach. But they were larger than in the former case, and more analogous to the substance, of which the capsulæ renales are composed.

§ 158. The nervous funicles sometimes undergo a peculiar alteration in certain tumours of the abdomen.

These tumours, which may be called *heterogeneous*, in consequence of the dissimilar lobes of which they are composed, frequently rest upon the sacrum and lumbar vertebræ, surround the aorta, enclose within them the crura of the diaphragm, reach into the epigastric region, push the transverse colon from its usual position, elevate the gastro-hepatic omentum by which they are covered, and constitute in one case a dense lobulated and lardaceous, and at another, a pultaceous and hydatid mass; these tumours are more or less vascular, and gradually

extinguish life by the production of hectic fever. I concluded, at first, that the nervous branches might be traced through these tumours, but on making an examination, discovered that they were most generally *ruptured* in these cases. In a tumor situated upon the lumbar vertebræ *behind the peritoneum*, I found the origin of the hypogastric plexus which is there formed by two roots, entirely divided so as to consist of two parts, a superior and inferior. The *former* terminated in a gangliform tumor, similar to those which the nerves exhibit, after the formation of a cicatrix, from the amputation of a limb: the *other*, although separated from the former about the space of a finger's breadth, did not appear either attenuated or shrunken. I examined another tumor of the same kind, which extended up towards the epigastric region, and firmly adhered to the lesser curvature of the stomach. Both the pneumogastric nerves were ruptured in this case, of which the right formed a slightly elongated ganglion, from which three tender filaments proceeded formed of a substance, which was of nearly the same character as the tumor in which they run. The patient, a man forty-seven years of age, in whom this tumor was found, was suddenly seized with cardialgia, and tortured with severe pain in the spine of the back, and between the scapulæ. Obstinate constipation and violent tormina succeeded to these symptoms, under which the sufferer finally sunk in the lapse of seven weeks. This truly inveterate organic disease was not manifested during its production by a single symptom, until the pneumogastric nerves were forced apart, and finally lacerated by the daily increasing size of the tumor; when the most violent phenomena were developed. It was, no doubt, the vellication of these nerves, transmitted to the right semilunar ganglion, and to the trunk of the right sympathetic nerve, which produced the intense pains of the abdomen and dorsal spine.

§ 159. It is not only in individuals of advanced age that the sympathetic nerve exhibits organic changes; it is likewise affected with singular alteration in the embryo; from which it appears, that it is obnoxious to diseases at the most tender period of life.

A tumour of a yellow colour was found upon the thoracic portion of the trunk of the sympathetic nerve. This colour, which was a golden yellow, did not appear to exist upon the surface of the nerve, but was peculiar to the nervous pulp; it could not be removed either by water or alcohol, or destroyed by the action of the solar rays. The medulla spinalis exhibited the same affection: for the whole of its substance was of a citrine colour, and when surveyed with a microscope, presented innumerable brown points to view, as if a fine red powder had been sprinkled upon and mixed with the nervous pulp.

This disease, which I think should be called *Xirronosos*,* I have detected in three embryos of four months, in which the serous membranes, to wit; the arachnoid, pleuræ, and peritoneum with its reflections, were likewise tinged with a yellow colour. The other organs, common cellular texture, skin, etc. were not in the least affected; and which is remarkable, neither the brain or its nerves, nor the spinal nerves themselves, were altered from their natural condition.

The causes of this disease, and the effects which it may produce in the economy of the embryo, are not, as I believe, entirely hidden from us.

From all that has hitherto been said, it follows, that the nerve, of which we have undertaken to illustrate, the structure and function, constitutes firstly, a peculiar system in the animal economy, which is not derived from the brain and spinal marrow, though it communicates with them in a multiplicity of ways; secondly, that it is designed for certain definite functions; thirdly, that it is not only capable of being affected in its powers and properties so as to produce dynamic diseases, but that it also exhibits alterations in its structure, perceptible to the senses. And if the attention of anatomists become directed towards these alterations, it cannot fail, but that we shall hereafter be supplied with ampler knowledge of the pathology of the human sympathetic nerve.

* From χλωρος, golden yellow, and νοσος, disease.

ADDENDA.

I.

To § 48, 49, 50. A recent and careful inquiry by the skilful Doctor EHRMAN, superintendent of the anatomical department of our medical Faculty, has convinced me of the following respecting the discovery of JACOBSON.

The ganglion of the glosso-pharyngeal nerve gives off a conspicuous branchlet, which enters through a foramen in the inferior face of the petrous portion of the temporal bone, into a canal which is engraved in the bone. This branchlet, when it arrives at the promontory, is divided into three filaments; the first of which extends towards the fenestra rotunda; the second, ascends and is united to the superficial vidian or petrous nerve; the third, runs forward, penetrates from the tympanum through the osseous septum into the carotid canal, and mingles in the nervous plexus, around the carotid artery.

In one subject the glosso-pharyngeal ganglion received a communicating branchlet from the superior cervical ganglion of the sympathetic nerve.

II.

To § 34. Doctor EHRMAN above cited, likewise examined after the celebrated TIEDEMAN,* the uterine nerves in two subjects. In the first case, in which the woman had died the seventh day after parturition, numerous branches were seen accompanying both the spermatic and uterine arteries. A few of the filaments of these nerves were spread upon the superior part of the vagina.

In the second case, in a female subject who had been destroy-

* Plates of the uterine nerves. Heidelburg, 1822: in fol.

ed by a slow fever in the sixth month of pregnancy, the nervous branches were found still more numerous than in the preceding case, having exactly the same origin and course that TIEDEMAN has described in this work above cited.

All these filaments having proceeded to the uterus, permeate its outer membrane, and are lost in the superficial stratum of uterine fibres. I think it may be inferred from this circumstance, that when the external coat of the uterus is removed, there exist many fibres which decussate each other in various modes, and are united together by the aid of loose cellular texture, as well as to the deeper and denser substance of the uterus. These fibres, of the character of which I am ignorant, may be readily assumed as the continued branches of nerves, but from which they differ, not only in relation to their direction and greater thickness, but also in being of a more flattened form. But in whatever manner these uterine nerves may terminate, it appears to me as certain and conclusive, that they do not enter into the substance of the uterus.

III.

To page 93, and page 106. What I have said in this work from hypotheses in regard to the nervous influx into the muscular structure of the diaphragm, has been since confirmed by the experiments of MOGUNTIA.* When the splanchnic nerve was armed with the zinc pole, and the copper pole placed in connection with the portæ of the liver, strong convulsions were produced in the diaphragm and pectoral muscles. The latter, no doubt, were drawn into consent by the action of the diaphragm. Here it is manifest that the nerves of the liver transmitted the galvanic stimulus to the diaphragmatic plexus. Therefore the branchlets of the sympathetic nerve, are placed in the same relation to the muscular fibre as the branches which are derived from the cerebral and spinal nerves.

* Galvanische und electrische Versuche an menschen und Thierkorpern angestellt, von der medizinischen Privat-Gesselschaft zu Maynz; 1803 in 4to.

IV.

To page 106, after No. 3.

4th. The experiments which have been made upon living animals, teach that there is no proper regeneration of the nervous substance, but that the two portions of a divided nerve are united together by the intervention of a kind of callous node. These experiments also prove that the functions which were suppressed in these nerves, are, after a little interval, restored.

The same thing occurs in those cases in which the nervous stamina are ruptured in their course by a tumour arising between them.

It is perfectly clear from these observations that beside the medulla and neurilema there is an imponderable principle in nerves which passes without impediment through this adventitious substance, like the electro-galvanic agent, which is moved round in the animal circuit, (to wit, nerve and muscle) although it may be interrupted by the interposition of a foreign substance, as a vegetable for instance.

FINIS.

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ADDENDA.

Plate I

Fig I.

Fig II.

Fig. IV.

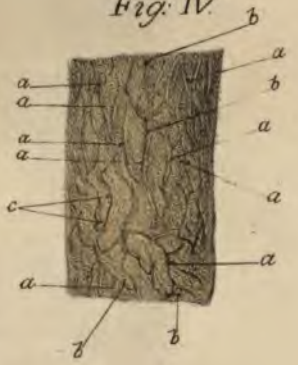

Fig: V.

P. Ancora. del.

Kennedy & Lizars. Lith.

Plate I

Fig I.

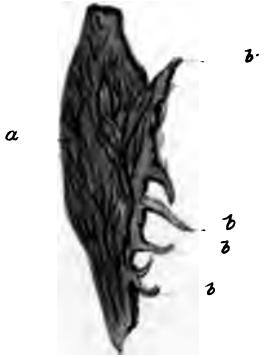

Fig II.

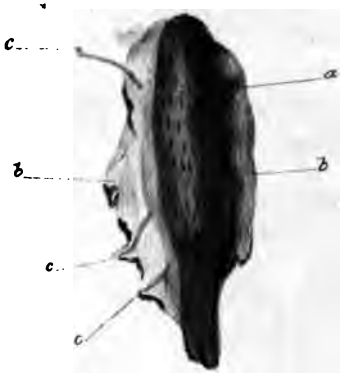

Fig. IV.

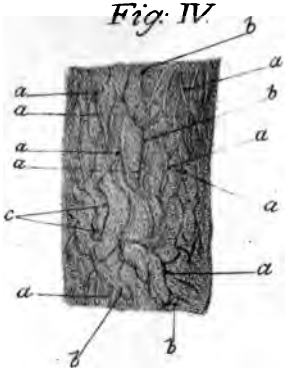

Fig: V.

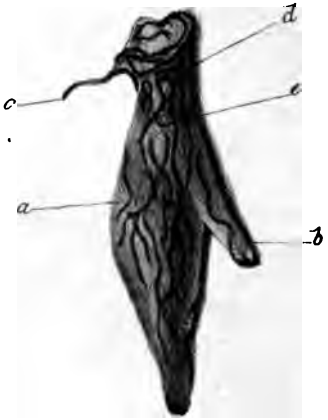

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PLATE I.

Vessels of the Ganglia.

Fig. 1.

Superior cervical ganglion of the natural size; the arteries filled with a yellow wax injection.

a. Ganglion enveloped by its tunic.

b b b b. Small arterial vessels arising from the neighboring branches of the carotid artery, and forming a network in the second cellular tunic of the ganglion.

Fig. II.

Superior cervical ganglion, rendered very red by the injection of the vessels contained in its tunic.

a. The naked substance of the ganglion.

b b. The tunic of the ganglion separated and spread out.

c c c. Small nerves in this reflected tunic. In the substance of the ganglia very minute vessels are seen running between the nervous filaments.

Fig. IV.

A microscopical view of a transverse section of the ganglion, with the vessels injected.

a a a a a. Trunks of the vessels.

b b b b. Small flexuous vascular branches running out laterally, broken off perhaps, in removing the involucra of the ganglia.

c. Two corpuscles, which appear to be formed by the *orbiculo-tomentose*, or *globular* substance. The remaining congeries of the vessels may be readily detected without the aid of references. All these vessels run in the direction of the ganglion, and compose the principal part of its structure.

Fig. V.

View of the veins in the superior cervical ganglion.

a. The ganglion itself.

b. A branch called *mollis*, given off by the ganglion.

c. The trunk of a small vein.

d. Venous plexus, arising from the same trunk.

e. Branches emanating from this plexus, and running in the direction of the ganglion. All these vessels are found in the second tunic of the ganglion.

PLATE II.

A representation of the right semilunar ganglion; in Fig. 1, *of the size of nature; and in Fig.* 2, *magnified to twice its usual dimensions.*

Fig. I.

a. Greater splanchnic nerve divided into six or eight fasciculi.

b. Branches anastomosing with the dorsal nerves.

c. Semilunar ganglion.

d d d. Branches given off by the ganglion, to form the superior mesenteric plexus.

e e. Two foramina, with which the ganglion is perforated.

Fig. II.

a. Fasciculi of the splanchnic nerve entering the ganglion.

b b. Small nervous bands running through the ganglion and collected below into,

c c c c c. Branches that emerge from or are given off by the ganglion.

d d d d d. The *orbiculo-tomentose* or *globular* substance interposed between the bands, and in which the latter are applied and interwoven.

e e. Two foramina, with which the ganglion is perforated.

Plate. II.

Fig. II.

Fig. I.

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Plate. III.

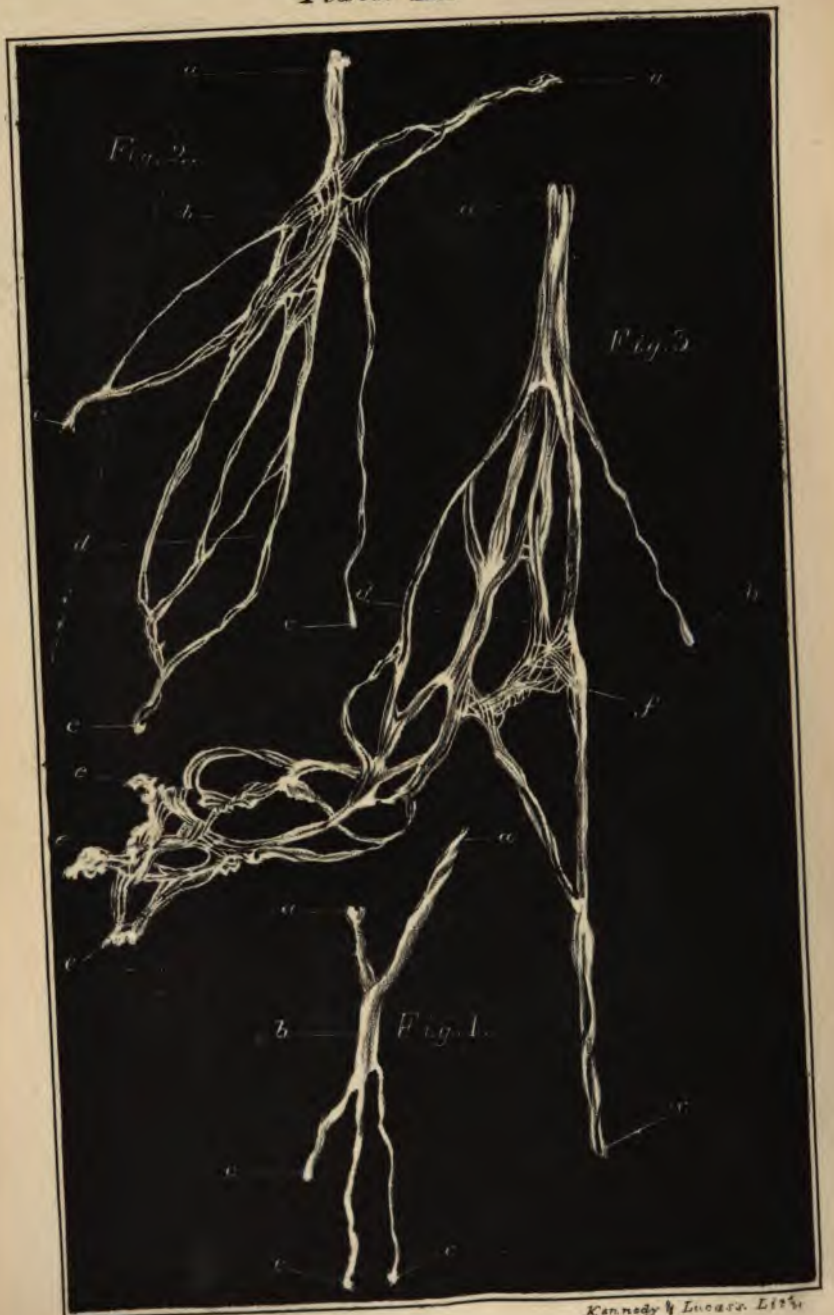

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PLATE III.

In this plate the nervous branches are represented as if they were fastened upon a black board. In this way the character, division, and course of the minutest filaments are better seen.

Fig. I.

a a. Two branches of the hepatic plexus, which, after uniting into a single trunk, (*b*) are quickly divided again into three parts, (*c c c.*)

Fig. II.

The same nerve magnified to twice its natural size, and unfolded into a plexus. This figure is thus represented under the microscope in order to furnish the best view possible of the direction and interlacing of the minutest filaments. I wish to exhibit by this preparation, contrary to the opinion entertained by BICHAT, that the branches of the nerves of the ganglia, are similarly situated, and form plexuses in the same manner as the branches of the cerebral and spinal nerves.

d. Represents the branch (*e*) unfolded into a plexus. The other references indicate the same as in Fig. I.

Fig. III. A representation of the anastomosis of the *right par vagum* with the *solar plexus*, in the body of an infant, increased to twice its natural size by the microscope.

a. Right par vagum.

b. Branch given off to the stomach.

c. Branch to the posterior part of the stomach.

d. Fascia communicans of WRISBERG, unrolled into a plexus.

e e e. Ganglionic branches of the solar plexus.

In examining this preparation with the microscope, the very delicate filaments of which these branches are composed, could be readily seen running from the par vagum to the ganglia, and vice versa, arising from the ganglia and running to the par vagum without any interruption in their course. There was also exhibited an interweaving of the minutest filaments, deserving of attention, in several places, and especially in that indicated by the letter *f.*

PLATE IV.

A representation of the inflamed semilunar ganglion, described (§ 141.) *in the pathological portion of the work.*

a. Trunk of the splanchnic nerve in the thorax.

b b b b. Origin of the same from the thoracic ganglia.

c. Portion of the trunk, near the ganglion, greatly increased in size.

d. The ganglion itself, of a vivid red at its upper portion, and of a livid hue at its inferior.

e e e e. Branches given off by the ganglion.

f. Branches to the renal plexus.

g. A portion of the right emulgent artery.

Plate IV.

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Plate V.

Fig. I.

Fig. II.

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PLATE V.

Fig. I.

The solar plexus of an infant, the disease of which is described (§142.) The nerves were drawn and painted immediately after the dissection.

a. Aorta.

b. Right splanchnic nerve, terminating in the solar plexus of the same side. This part was found in its natural condition.

c. Left splanchnic nerve, terminated in the ganglion, and red from inflammation.

Fig. II.

The same parts after a maceration of four days in water. The left part of the solar plexus exhibiting a different colour from the right.

PLATE VI.

Fig. I.

A representation of the carotid artery, removed from its canal in the petrous portion of the temporal bone, with the branches of the sympathetic nerve.

a a. Internal carotid artery.

b. The reddish plexiform carotid ganglion of the sympathetic nerve.

c. Three branches proceeding from the ganglion upwards to the sixth pair of nerves (abductor oculi.)

d d. The nerve itself (6th pair) divided into two fasciculi.

e. Superior fasciculus.

f. Inferior fasciculus, separated from the former by a sulcus. The three branches of the ganglion unite with this fasciculus.

g. Branch running to the ganglion from the deep-seated Vidian nerve.

h. A twig from this branch to the tunics of the artery.

i i. Two branches sent from the ganglion to the artery.

k. A branch proceeding from the ganglion behind the artery, to the trunk of the intercostal nerve.

l. A principal branch descending from the ganglion on the upper surface of the artery, divided at the letter (*m*) into two portions.

Note. All these branches were carefully drawn out a little from the artery, and depicted in that position, in order that their disposition might be more clearly exhibited.

Fig. II.

Intercostal nerve of an infant, described (§ 143.)

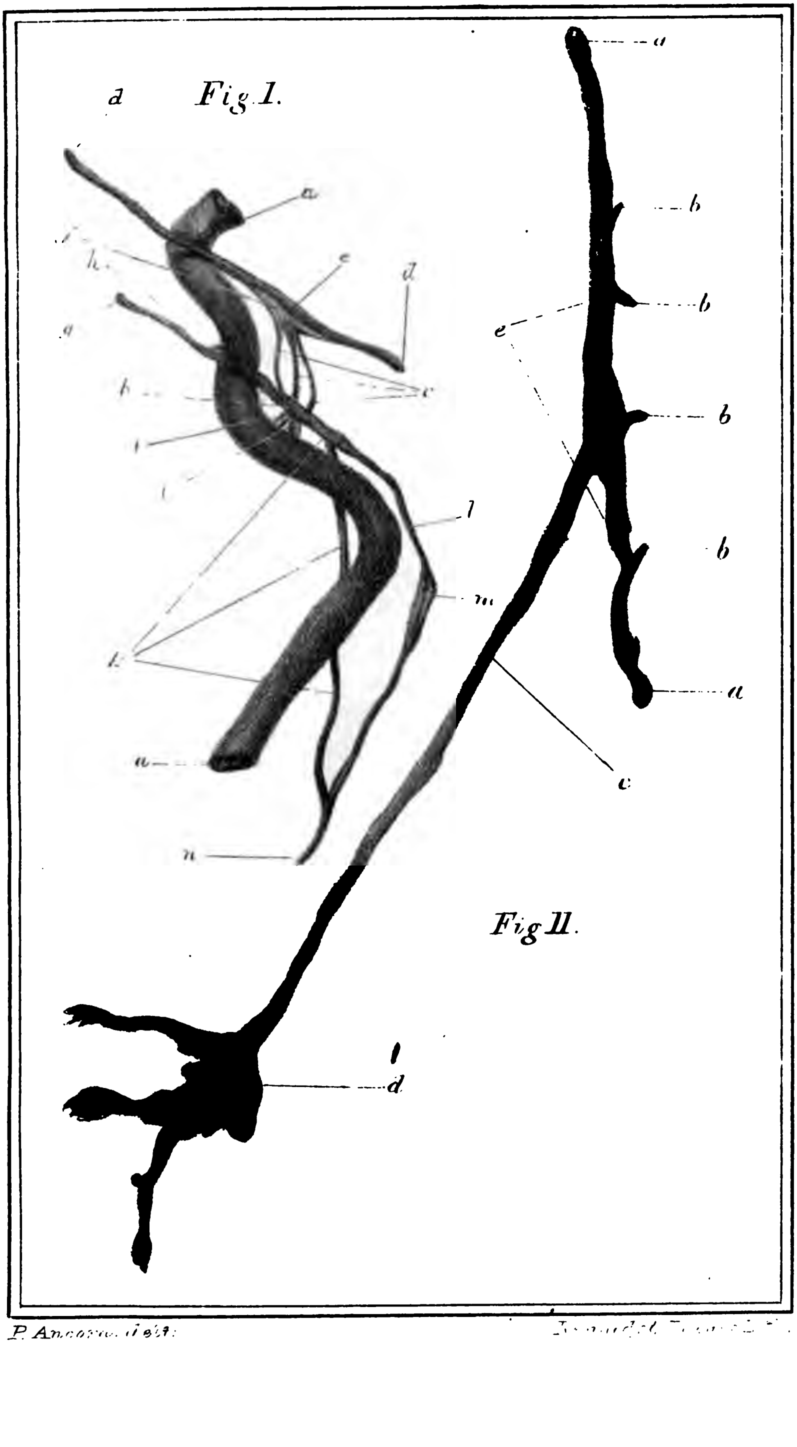
a a. Trunk of the intercostal nerve of the left side.

b b b b. Branches anastomosing with the spinal nerves.

c. Splanchnic nerve.

d. Semilunar ganglion, much redder than usual.

e. An inflamed portion of the trunk of the intercostal nerve, including the ninth and tenth thoracic ganglia.



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